Improving micropropagation of hardy ornamentals using forced ventilation

Lack of ventilation of culture vessels leads to poor plants and high mortality.
A technique borrowed from nature looks promising as a way of overcoming the problems

The challenge

Micropropagation supplies a small, but significant proportion of the plants raised in the UK, particularly of hardy nursery stock species. For the UK industry to be competitive and increase its share of home and overseas markets it must continue to reduce production costs and overcome the difficulties of micropropagating some of the more difficult species that could supply profitable niche markets.

The opportunities

The plants which have proved difficult to micropropagate show a range of symptoms in culture including poor growth, chlorophyll deficiency, leaf drop, growth abnormalities and high mortality when moved on into the glasshouse to be weaned.

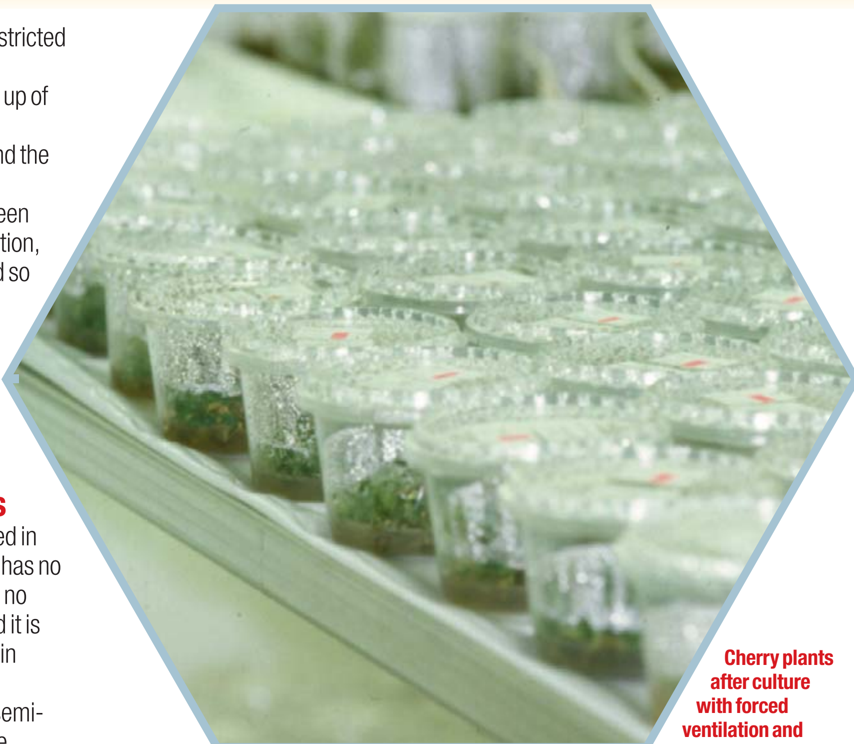
These problems are thought to be associated with poor ventilation of the culture vessels. Capping them with cotton wool, screw tops, cling film etc can prevent gaseous exchange with the atmosphere or only allow restricted diffusion. This leads to a high humidity, restricted carbon dioxide levels for photosynthesis and a build up of toxic volatile substances, particularly ethylene, around the plantlets.

Forced ventilation has been shown to improve the situation, but the methods developed so far are expensive and complex, requiring compressed gases or pumps and often gas mixing or metering devices.

Research methods

The system being developed in this project is far simpler. It has no moving parts, and requires no external energy supply. And it is based on a principle found in nature to ventilate the underground rhizomes of semi-aquatic species such as the common reed, *Phragmites australis*.

Termed humidity-induced diffusion, the system uses microporous membranes with different pore sizes. Used in a single unit which is attached to the culture vessel, these membranes create a steady flow of humidified, sterile air with atmospheric



Cherry plants after culture with forced ventilation and 100% CO_2 enrichment (top) and conventional diffusive ventilation and 62% CO_2 (bottom)

"A successful outcome will make the UK industry more competitive"

Martin Squire
Parigo Laboratories

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concentrations of carbon dioxide and oxygen which flushes the vessels virtually free of ethylene.

An accessory device for enriching the ventilation stream with carbon dioxide, to promote photosynthesis, has also been invented and is being patented.

Progress

Plants micropropagated with forced ventilation are tougher and woodier, and they lay down more food reserves as starch. Leaves of plantlets grown under conventional conditions tend to have a poor wax covering and have pores on the leaves, the stomata, that gape open and so they lose water rapidly when they are taken out of culture. With forced ventilation the stomata function normally and the wax cover is more complete so the plantlets are better able to survive the weaning process.

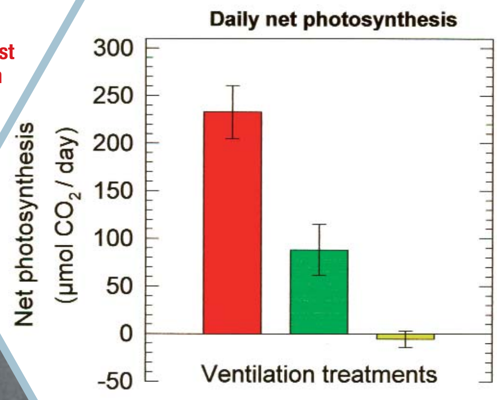
This not the only benefit from forced ventilation. The rate of multiplication is improved, shoot death and leaf drop decrease and contamination by pathogens and pests is greatly reduced.

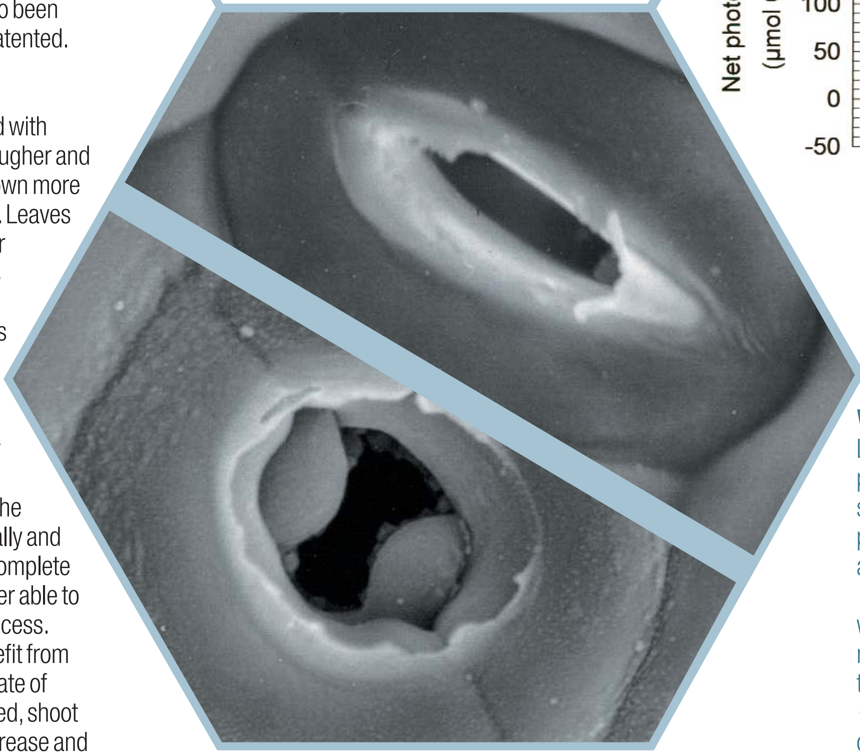
Benefits to the industry

The application of the forced ventilation system opens up the prospect of greater profitability for UK plant raisers through an expansion of the range of micropropagated plants produced in the UK and improvements in plant vigour, multiplication rates and survival.

A computer-generated mathematical model will predict the efficiency of the forced ventilation and carbon dioxide enrichment system for particular culture vessels. This will reduce the number of physical trials that need to be done and allow the potential benefits to be delivered more rapidly to growers.

Photosynthesis benefits most from forced ventilation with CO_2 enrichment (red). The rate decreases without CO_2 (green) and falls lower still with conventional ventilation (yellow)





Normal stomatal development and function in *Hesperis* with forced ventilation (left). With conventional ventilation (right) the stomata gape and tend to lose water

"We know the forced ventilation system will produce more robust plants"

Dr Jean Armstrong
University of Hull

What is HortLink?

LINK is the UK Government's principal mechanism for supporting collaborative research partnership between UK industry and the research base.

The HortLink programme was launched in 1996 and has now been extended. The aims of the extended programme are:

- To improve the sustainability of the horticultural industry.
- To improve knowledge and understanding of processes and factors which determine the performance of the horticultural industry.
- To enable access by the horticultural industry to innovative ideas and technology by involving a wide range of research institutes and university departments.
- To promote wider awareness of the benefits of advanced horticultural techniques/ methods, especially to SMEs.

Further information from the programme co-ordinator.
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LINK COLLABORATIVE RESEARCH

Project details
Improving micropropagation and weaning of slow growing hardy ornamentals (HONS) by application of novel forced ventilation techniques

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HORT 205

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