at 35°F and the other has the temperature maintained in the root zone at 20°F In both cases we have overwintered rooted evergreen azalea cuttings

MODERATOR SHUGERT. What future does the poly bag container have in the U S.?

FRANK GOUIN· The problem has been to get a good poly bag on the market. Machinery is a problem for automatic potting. My work has shown that you get better growth in the poly bag because as the soil loses water and shrinks the bag also shrinks. You get much more uniform moisture. Once we get a bag that will stand up over time and drain properly the cost of poly will dictate wider use. Few people handle the plants by the container so that is not a problem.

BEN DAVIS: At the Texas nursery meeting I visited a California company that is using the poly bag and has potting equipment to handle the bags

MODERATOR SHUGERT· How can I propagate *Fothergilla*?

MICHAEL DIRR. Very easy from cuttings taken in June or July and treated with 1% IBA as a quick dip. Watch when you overwinter them. Do not disturb until they have completed a normal dormant cycle

Friday Morning, December 11, 1981

Leonard Stoltz served as moderator of the morning session

TISSUE CULTURE FOR THE PRACTICAL PLANT PROPAGATOR — STATE OF THE ART

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Tissue culture has become an important tool for use by the commercial plant propagator. This technique offers a number of advantages including easier production of many difficult to propagate plants, rapid increase of newly introduced cultivars and the ability to propagate desired plants continuously or at any time throughout the year. When the micropropagation aspects of tissue culture are combined with appropriate indexing and explant establishment techniques, then tissue

culture provides the opportunity of producing large quantities of vigorous, uniform plants free of known diseases.

Establishing a tissue culture production facility requires a considerable investment in time and money although methods for minimizing these costs have been described (6). In addition, the unit cost of micropropagated plants can be higher, sometimes considerably higher, than the cost of conventionally propagated plants. This cost may be acceptable, depending upon the purpose for which the plants are being propagated, but the propagator must be aware of the costs involved in this technique.

The first requirement for every commercial nursery is that it must be a profit-making operation to remain in business. A decision on whether or not to use tissue culture technology as a part of the overall nursery operation must take into account this requirement for profitability. In some cases, the plants propagated in tissue culture have unique characteristics, e.g. freedom from disease, new cultivar unobtainable by other means, etc., so that a high cost per plant can be acceptable. However, when using micropropagation as an alternative method for propagating plants for sale, care must be taken so that the cost of propagating the plant does not exceed its sales value. I have visited laboratories where I suspect the tissue culture produced plants are being sold at little or no profit or at a loss. This situation probably results from inadequate cost accounting procedures and an overly optimistic view of laboratory efficiency. Little information has been published on unit costs of tissue culture propagated plants (3,7) but that which has suggested that unit costs may be relatively high, particularly for plants which do not proliferate rapidly or root readily.

One result of the relatively high cost per micropropagated plant has been a shift in emphasis to micropropagating plants that have a higher value. Thus, some laboratories in Italy have greatly reduced the number of strawberries being micropropagated for direct field planting and have substituted rootstocks for various fruit trees, the per plant value of which is much greater Similar changes are occurring in North America, where higher value ornamental trees are starting to be micropropagated preferentially over fruit tree rootstocks. This change is also a result of laboratory operators attempting to broaden their product line in order to maximize the utilization of their facilities. Operators of independent laboratories appear to rely mostly on contract orders. This method of operation seems to work out well given the reluctance of many nurserymen to make the investment required for setting up and operating their own tissue culture laboratory.

A striking feature of micropropagation of horticultural

crops, particularly certain woody ornamentals such as rhododendron, is the rapid development of the technique by commercial laboratories. While the basis for micropropagating rhododendrons was developed by research scientists, particularly Anderson (1,2). several commercial nurseries have pressed forward very rapidly with the application of these methods and now have more than 70 cultivars of rhododendron in production as well as a number of azalea cultivars. This progress has required considerable development and refinement in the technique by the operators of these laboratories but the research they have done is now paying off in the production of vigorous, uniform plants. As a result, the commercial application of tissue culture to some of these crops has moved far ahead of the academic research on the same ones. Most of the information developed by the commercial laboratories is unpublished so that direct communication with the persons actually doing the work is the only way to keep abreast of this rapidly changing field.

One potential problem arising as a result of these rapid developments is whether the micropropagated plants are being adequately tested for genetic stability. Most plants being micropropagated will probably prove to be phenotypically stable but some testing is required to ensure that this is the case (5,8,9). When the micropropagated plant is grown for its flowering or fruiting characteristics, then a large enough sample of the plants must be grown to guarantee that the population, as a whole, is phenotypically stable. Failure to do this could have serious consequences. If buyers even think that they are getting off-type plants from micropropagation. the economic impact will be severe, not only for those plants showing some instabilities, but also for those which are phenotypically stable

The requirements for setting up a tissue culture laboratory have been thoroughly described by Damiano (4) but within the general requirements, many alternatives are possible The alternatives selected depend upon many factors including resources available, crops to be propagated, users of the plants produced, and whether the laboratory is independent or part of a nursery.

The many successful laboratories now in operation illustrate the use of a wide range of laboratory plans. specific equipment, and management practices These laboratories range from 2-3 person operations with a single work station for transferring cultures to those having 10 times as many employees with more than 20 work stations for transferring cultures, sometimes working more than one shift per day. Sterilization of media is accomplished using equipment ranging from sim-

ple pressure cookers to large autoclaves costing more than $50,000. Transfer hoods range from simple, home-built units circulating only filtered laboratory air to laminar flow hoods providing a sterile work environment for as many as 4 workers at a single hood Similar differences exist in types of culture containers, growing media, and acclimatization procedures. The point to be made, however, is that each problem, each step in the procedure, has a number of solutions which work equally well. The problem becomes one of selecting a course of action for setting up a laboratory, or for establishing the details of propagating a particular plant once the laboratory is set up, and following that course through to a successful conclusion. Successfully solving the problem hinges on effective management. No amount of investment in equipment, facilities, or personnel can replace it.

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