horticulture crops. I. Induction of callus and differentiation of organs in anther culture of asparagus. *J.Jap. Soc. Hort. Sci.* 41:272-280.

24. Yang, Hsu-Jen and W.J. Clore. 1973. Rapid vegetative propagaion of asparagus through lateral bud culture. *HortScience* 8:141-143.
25. _____ and _____. 1974a. Development of complete plantlets from moderately vigorous asparagus shoots of stock plants *in vitro*. *HortScience* 9:138-140.
26. _____ and _____. 1974b. Improving the survival of aseptically-cultured asparagus plants in transplanting. *HortScience* 9:235-236.
27. _____ and _____. 1974. In vitro reproductiveness of asparagus stem segments with branch-shoots at a node. *HortScience*. 10:411-412.
28. Young, R.D. 1939. Yield-growth relationships in asparagus *Proc. Amer. Soc. Hort. Sci.* 35:576-577.

MASS PRODUCTION OF BOSTON FERN THROUGH TISSUE CULTURE

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I will discuss the practical aspects of tissue culturing for the purpose of mass-producing plants for a commercial nursery. It has just been in the last few years that the work of tissue-culturists, such as Dr. Tosh Murashige at the University of California, Riverside, has been tried in practical applications by commercial nurseries. This discussion will concern the application of tissue culture for the mass production of Boston fern [*Nephrolepsis exaltata* 'Bostoniensis']. We have learned much from Dr. Tosh Murashige at the University level, but we have found that their procedures and techniques must be amended when applying them to a commercial lab. We haven't the funding, time, nor the high quality of personnel that a University has, so we have adopted their techniques to our own special requirements.

The actual proliferation of the ferns begins with the stolon tips, or runner tips, from a parent plant. The tips are collected and brought to the "clean air" station where they are sterilized by placing them in a bleach solution for a given amount of time, then they are run through sterile water baths to assure the removal of any bleach residue. At this time they are then placed on the medium which is enclosed in a culture tube or flask. From here they go to the culture room for growing. The initial growing time from this tip to plants large enough to divide takes about 2 to 3 months. After this initial 3 months the plants are divided into individual plants and placed back on fresh medium. It now only

takes 6 weeks before the plants are ready to be divided again. The process of sub-dividing the cultures can be repeated as many times as desired but it is not necessary to do this.

Since this article is about mass production, I will indicate the actual numbers that can be produced. A good technician could turn out about 600 stolon tips in a day. If we did 600 tips a day, the final numbers would be much too large to handle; a lab staff of 20 to 30 people would be needed to handle such quantities. If the plants were grown to 4" pot size, six acres of houses would be needed to house the volume. At the transplant stage we have six trained people to do the sub-dividing of the cultures. One person prepares the media, and one person takes care of the culture room. So, for practical reasons, we keep the initial numbers more conservative. Let's say the technician does 100 stolon tips on a given day. Three months later these 100 plants are divided up for the actual division. I'll use a conservative number. Cultures can be sub-divided to as many as 30 plants, but let's say every culture yields 5 new plants so we now have 500 plants in the first generation. Six weeks later they are divided again to obtain 2500 plants in the second generation. In another six weeks the process is repeated to obtain 12,500 plants in the third generation. From here they are placed on a medium which is designed to slow down their multiplication and initiate root growth in preparation for planting out in the nursery. This growth period is also 6 weeks, at the end of which the plants are placed into soil in a special room or greenhouse for adaptation to soil and greenhouse conditions. At this stage they only multiply about three times — so when they are placed into soil, we've obtained about 37,500 plants in a span of about 9 months. This can be put on a schedule to allow that many plants a day to be produced, which would result in about 750,000 plants per month. This figure is too large for most nurseries to handle but it is possible. For smaller numbers the initial number of plants can be adjusted to meet any number that is desired. With this technique a certain amount of plants can be programmed to be produced every day or at any time interval desired. With preplanning, larger crops can be produced for special times when sales are high, for example, the various holidays.

The last phase of the operation is the process of hardening off plants from a sterile artificial environment to a greenhouse environment and ultimately the home environment. This process is a relatively simple one. When the cultures are removed from the flasks or jars they are rinsed in water to remove any agar medium and then they are placed into soil in cell packs. These ferns are very small, less than ½ inch in height. The cell packs are placed into high humidity tents for about two weeks or until they establish some roots into the soil, after which they are taken out of the

tents and placed in a greenhouse for further growth and hardening off. They become a good size cell pack fern in about 6 to 8 weeks at which time they are stepped up into a 4-inch pot. The room which houses these high humidity tents also needs to be kept clean to reduce the introduction of any unwanted pathogens and resultant disease losses.

In summary, I have outlined the practical application of tissue culturing in a commercial lab. Large numbers of plants can be obtained and be on a regular schedule through proper programming and management.

There are many other plants in the foliage industry which can be mass produced through a tissue culture lab. We have worked on media for Dieffenbachias, a variety of Dracaenas, Red and Green Marantas, Calatheas, Kalanchoes, different succulents, Cordylines, and a variety of other ferns. We are able to grow all of these in a culture, but only about half have shown promise on a commercial level for the mass production of the plant. Some of the plants stll are propagated faster through conventional propagation methods, but as time goes on we will be able to produce larger numbers of any plant desired. All plant growth can be preprogrammed to obtain a given number of plants on a given day. Continuing into the future we may expect to see rapid increases in the variety of plants cultivated by sterile techniques and, in consequence, extensive benefits for man's need of food, lumber, medicine, and ornament.