13. Buck, J.A., 1973. High intensity discharge lamps for plant growth application. *Trans. Amer. Soc. Agric. Eng.*, 16:121-123.

14 Weir, J. 1975. Artificial lighting for commercial horticulture. *Lighting Research and Technology*, 7:209-225.

SMALL FRUIT CULTURE AFTER THE TEST TUBE

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There is an important transition period which tissue cultured plantlets must experience between the protected environment of the laboratory and the harsh world of the greenhouse. In fact, the ability to survive this transition is limiting the commercial use of tissue culture for some species. However, plants of some cultivars survive this crucial stage more easily than others.

Growers know that field-grown plants require good growing conditions: fertile, well-drained soil, proper watering, and nutrients. Tissue-cultured plants also require good growing conditions: controlled environment of heat, light, and chemical nutrients. Between these two very different growing conditions is a transition facility for preparing *in vitro*-propagated plants for growing on. The requirements for this facility differ according to the cultivar being grown.

This year we propagated 40,000 strawberry plants by tissue culture for growers who sell certified strawberry plants. We grew 'Hood,' 'Benton,' 'Olympus,' 'Totem,' 'Shuksan,' and 'Quinault' cultivars (2). We took the plants out of culture jars and put them directly into bedding plant containers in the greenhouse; our mortality was essentially zero. Caneberries, on the other hand, take considerably more care.

We programmed for field-ready strawberry plants on April 1. Strawberry meristems were started in culture in July. They multiplied in test tubes, then in mason pint jars, for four or five months, multiplying, in some cases, as much as six to one in ten days. Following the multiplication stage they were placed in rooting agar in pint jars for four to six weeks. We transferred the rooted plantlets from the jars into the greenhouse mostly between January 15 and February 15. The days were short, mostly cloudy and rainy, and cool to cold. Because of woody hillsides, we have less than five hours of direct sunlight on our greenhouses on February 1. The greenhouses are quonset style pipe houses (14′ by 90′) with inflated double-

walled polyethylene covers that are tightly sealed; the humidity, therefore, is always very high. Heat is provided by circulating warm water in pipes in the floor. The floor is of ash, much like sand, from the local coal-fired steam plant. No supplemental light was provided. On sunny days the temperature in the greenhouse would go over 90°F; night air temperatures kept above freezing, but greenhouse floor temperatures usually held above 60°F. A small fan (4500 c.f.m.) moved greenhouse air.

We planted directly into six-packs using a very porous, fertilized, standard greenhouse mix with a pH close to that in culture, about 5.7. The trays of six-packs were set directly on the warm floor. We sprayed with Captan to discourage *Botrytis*. Normally we pot 30 plants from a one pint mason jar; however, with some cultivars the multiplication continues in the rooting medium such that we have taken as many as 100 Totem strawberry plantlets from a single jar. We can count on high survival only by those plants which have well developed roots, usually at least two roots an inch or longer, and which have a solid appearance to both stem and roots, as opposed to a succulent, watery appearance. We watered in the plantlets as soon as they were planted then, subsequently, hand watered as required, using a Peter's 20-20-20 fertilizer mix when we watered.

This year we also tissue-cultured several thousand Boysenberry, thornless Loganberry, and Marion blackberry (1,3). Direct transfer of these berries from jar to greenhouse was not possible without mortality rates of 20 to 50 percent, under the same conditions that caused no mortality to strawberries. Without sophisticated controls in our transition facility we achieved survival rates of 90 percent, or better, by putting the potted berries in diffuse light under a polyethylene tent for two weeks. No mist was applied; they were hand-watered as required. A well developed root system helped but did not eliminate the need for control of light and humidity in the rather long transition period. The Loganberries, Boysenberries, and Marion blackberries, qualitatively, progressively, in that order, appeared more rugged or better able to withstand sunlight or lower humidity, with Marions the most rugged. These berries also took longer to start aggressive growth than the strawberries.

Currently, we are tissue culturing various caneberries for a customer who will take them as rooted plantlets. We are weighing the merits of rooting *in vitro* as opposed to rooting in potting mix in closed, clear plastic shoe boxes in controlled, growth room conditions. So far, the potting mix appears to promote more roots sooner.

There is need for a series of experiments for caneberries to take place in a controlled environmental growth chamber, or similar device, to establish the optimum limits of light and humidity at various temperatures, just as experiments have been conducted to establish auxin-cytokinin ratios and nutrients for *in vitro* propagation.

LITERATURE CITED

1. Anderson, W.C. 1980. Tissue culture of red raspberries. USDA-SEA Ag.Res. and ASHS Proc. of the Conf. on Nursery Prod. of Fruit Plants through Tissue Culture p. 27-34.
2. Boxus, P. 1974. The production of strawberry plants by *in vitro* micropropagation. *Jour. Hort. Sci.* 49:209-210
3. Zimmerman, R.H., and Broome, O.C. 1980. Micropropagation of thornless blackberries. USDA-SEA Ag. Res. and ASHS Proc. of the Conf. on Nursery Prod. of Fruit Plants through Tissue Culture. p. 23-26

THE AFTERMATH OF THE TEST TUBE IN TISSUE CULTURE

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Tissue culture at Briggs Nursery has been around for twelve years or more, mainly as a research project and the hope of one man.

There was work done at that time, but until the chemicals and the media were developed, success was minimal. Finally, Dr. Wilbur Anderson, from the Northwest Washington Research and Extension Unit, Mt. Vernon, Washington, was able to start rhododendrons in tissue culture and make them multiply. Afterward, by manipulating chemicals and lights, more and more cultivars were added.

Three years ago our Production Department started to receive plants from the Tissue Culture Department. At first there were only small batches, but the explosion was waiting. In the spring of 1980 we were faced with thousands of tissue culture plantlets to root and grow on.

The first problem we had to face was how to root and grow the new plantlets. The plantlets coming from the test tube were very tender and completely different in character than plant materials normally worked with at Briggs Nursery. This presented new problems for the people in charge of this phase of production.

Soil media had to be developed both for rooting and growing of the new plantlets. The media had to be well drained,