this year, set in Spencer-Lemaire containers, and placed in greenhouses. The resulting stock will be planted under production conditions in October, 1981.

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NEW HORIZONS IN ROOTING HORMONES

EDSAL A. WOOD

Bonsai Village
Wilsonville, Oregon 97070

My first remembrance of using a liquid rooting hormone goes back to 1951 when I tried a 24 hour soak of English holly in ethanol and IBA. After reading in Hartmann and Kester's text (1) on plant propagation the advantages of liquid hormones I decided this was the way to go. Since that time I have been involved with improving my abilities in rooting cuttings as a commercial wholesale grower. My first tests with ethanol as a solvent showed that with certain water sources as a diluent, a precipitate would form. From there I went to additional solvents to prevent this. After trying many, I found improved rooting was because of better penetration of the hormone through the plant tissue, I determined to find the best additional solvent for penetration.

To me, the reasons for using a liquid hormone are many. Firstly, you can select the concentration best for the species or cultivars you grow. The best concentration for any given plant is varied because of climate, fertility, water, age of plant, hardness of cutting, and time of year. The way you can deter-

mine the best concentration for your method of growing is by a series of bracketing three concentrations on a small number of cuttings. Another advantage is you can stock one hormone with an infinite number of concentrations possible, instead of stocking many powders with different concentrations, and still maybe not having the best concentration for your conditions. Also with a liquid hormone, you get better penetration of tissue and tend to form roots as deeply as you dip the cutting instead of getting roots mostly on the wounded basal end. The less concentrated forms require longer periods of soaks and are not as economically feasible. In addition, many times with a powder, if the cutting is too wet excessive amounts of powder adhere to the cutting and, if too dry, too little is retained. With a liquid dip all are evenly treated. With these things in mind I proceeded to formulate a liquid hormone.

As with the development of any new item, a multistage effort was started. First, as is usual, a literature search was done. Maybe the only difference with our search was the inclusion of medical literature. More effort has been given to animal tissue penetration than plants and, hopefully, something different would turn up. Concentration was given mostly to the dipolar aprotic solvents. Those that were chosen were sulfolane, dimethyl acetamide, dimethyl formamide, dimethyl sulfoxide, and acetone. Dioxane was also tried but rejected because of plant toxicity. The reason for choosing this group was that they were exceptionally useful in crossing through living tissue without undue toxicity.

Another group was chosen for the following characteristics: evidence of penetration, tissue tolerance, compatibility, and tissue preservative qualities. These were mannitol, sorbital, glycerine, and propylene glycol. Also included were magnesium sulfate and magnesium chloride for their properties of altering or improving crossing of materials through membranes.

The next step was a tissue penetration test of the materials, using Rhodamine B and Malachite green. Incidentally, Rhodamine B was the most effective for this purpose.

These materials were then incorporated with ethanol. Ethanol has many properties that make it the logical primary solvent. Besides it's highly solvent properties and price, it's high volatility allows the concentration of the auxin-like materials for absorption. These solvents were then used with indole-3-butyric acid and 1-naphthaleneacetic acid.

The last and final phase was the determination of whether or not they would aid in the rooting of plants. Twenty different kinds of plants were used in a blind study to determine

their rooting ability. An additional ten kinds of plants were then tested on the most promising formulations. Many of the easier rooting plants were almost equal in their response as would be expected. The most promising solvent in our tests proved to be dimethyl formamide. I will admit my evaluations were based on how quickly they rooted and with thirty years experience, which ones I would rather have to plant on. I would like to thank the Environmental Protection Agency for the way they worked with me in the approval of this formulation.

Now to address the title of this paper, research has commenced on several different projects. One a hydrophilic dip containing a fungistat and a rooting hormone for those bareroot trees that are hard to establish after storage. Another is a pressurized spray can containing a callusing agent, a fungistat, and with enough mechanical strength to hold a field bud in place without desiccation and allow the resultant growth to be unimpeded. Work is progressing on the rooting of plants in polyethylene in storage instead of in conventional media. Hopefully one or more will work out.

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GENETIC STABILITY OF HORTICULTURAL PLANTS PROPAGATED BY TISSUE CULTURE

RICHARD H. ZIMMERMAN

Horticultural Science Institute
Agricultural Research Service
U.S. Department of Agriculture
Beltsville, Maryland 20705

The term tissue culture, as popularly used, covers a multitude of cell, tissue, and organ culture techniques. The aspect of most interest to plant propagators is micropropagation, the rapid asexual multiplication *in vitro* of a desired plant. Most commonly, the explant used in micropropagation is a meristem-tip, shoot-tip, or bud that is induced to grow and then proliferate in culture. The basis of this procedure is the stimulation of new shoots *in vitro* by treatment with an appropriate plant growth hormone. A cytokinin in the culture medium stimulates growth of axillary and/or adventitious buds. The resulting shoots can then be rooted by transferring them to a medium free of cytokinin and containing an appropriate auxin