Juniperus communis 'Hibernica' — Irish juniper
Juniperus communis 'Kiyonoi' — Kiyono juniper
Juniperus communis 'Suecica' — Swedish juniper
Juniperus conferta — Shore juniper
Juniperus horizontalis 'Glauca' — Sargent's blue juniper
Juniperus horizontalis 'Plumosa' — Andorra juniper
Lagerstromia indica — crape myrtle
Punica granatum — pomegranate
Spiraea sp. — spirea
Thuja occidentalis 'Woodwardii' — Woodward globe arborvitae

MIXING ROOTING HORMONES

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By definition, "plant hormones" are chemicals occurring in living plant material that affect plant growth. Chemicals affecting growth that have not been isolated from living plant material are called "growth substances". For the purpose of this paper, both types of chemicals will be referred to as "hormones".

The process of mixing rooting hormones is a relatively new one, which affords the convenience of having on hand a wide range of concentrations and combinations of several rooting compounds. These various concentrations and combinations can, and should, be used to compare results produced on any given crop which is to be rooted in your nursery.

All of the compounds most commonly used as plant hormones are readily available from chemical supply houses (1) both in bulk or as pre-weighed samples. Naturally, the bulk material is least expensive.

Our first procedure deals with mixing rooting hormones with talc. I will use 3-indolebutyric acid (IBA), as an example. A brief look at the mathematics involved shows:

To make 100 gms. of 1.0% (10,000 ppm) IBA in talc combine 1 gm. IBA and 99 gms. talc

To make 100 gms. 4.5% (45,000 ppm) IBA in talc combine 4.5 gms. IBA and 95.5 gms. talc

A small amount of rubbing alcohol (70% isopropyl) is used to dissolve the IBA in a small container. This is poured over the talc in an electric blender. Additional alcohol is used to rinse the IBA container to be sure all of the IBA is recovered; this rinse is added to the talc. Sufficient alcohol is then added to the mix to make a thin, creamy mixture. This mixture is blended at high speed for 4 to 5 minutes.

A flat pyrex bowl serves well for the evaporation pan. The well-mixed solution is poured into the pan, the mixture is rinsed with alcohol and this rinse is added to the pan. The mixture is left in a warm place for the alcohol to evaporate. When evaporation is complete and the mixture is quite dry, the residue is scraped into a mortar and ground with a pestle until the talc is pulverized to its original fineness.

The IBA and talc are put into a clearly marked container more than twice as large as the volume of the mix. The contents of the can are mixed thoroughly with a mechanical paint can agitator for 10 to 20 minutes. At this point the IBA-talc mixture is ready to use. Heung, et al, (2) have shown (using IAA) that this alcohol solution method ensures a more uniform product than *simple mechanical mixing and will therefore give more* consistent results.

It is possible to use a combination of chemicals. We have used the following in *Rhododendron* propagation (3):

To make 100 gms. of 1% IBA in talc plus 5% Benlate and 50 ppm boric acid (3)

Combine: 1 gm. IBA, 10 gms. 50% Benlate, 5 mg. boric acid (USP), and 89 gms. talc (USP).

In this instance the IBA, boric acid and Benlate are dissolved in rubbing alcohol and added to the talc in the blender. The same procedure as given above is followed to completion. At this point I would like to emphasize that it is not my purpose to advocate or recommend specific mixtures to be used. I am simply presenting the mathematics and mechanics of mixing combinations of chemicals which can be used. The literature of this Society is full of excellent articles recommending specific concentrations or combinations for specific crops.

The next method deals with the mixing of rooting compounds with 50% isopropyl alcohol. Isopropyl alcohol is used because the 70% formulation is readily available at any drug store and is relatively inexpensive. The first step is to make a 50% solution of isopropyl alcohol.

To make 50% isopropyl alcohol

1000 ml. is equal to 1 liter

1 liter of 70% isopropyl alcohol contains: 700 ml. isopropyl alcohol, 300 ml. water

Add 400 ml. distilled water to 1000 ml. isopropyl alcohol which yields 1400 ml. of 50% alcohol.

(Dilution ratio is always 10 parts alcohol to 4 parts water.)

A 50% solution is used because it contains sufficient alcohol to afford reasonable solubility and yet is fairly stable; *i.e.* free from excessive evaporation when used during hot summer weather. Although there is a slight loss of volume when alcohol and water are mixed, the concentration is not significantly affected. If hormone concentrations are high it may be necessary to use 70% alcohol to get the material into solution. We also prefer to use 50% alcohol to reduce danger of plant damage.

To make 1 liter of 2% IBA

A 2% solution is equal to 20,000 ppm

1 ppm is equal to 1 mg./liter

2% solution contains 20,000 mg./liter

or

2% solution contains 20 gms./liter

20 gms. IBA + 770 ml. 70% isopropyl alcohol + 230 ml. distilled water = 1000 ml. 2% IBA

Here again 3-indolebutyric acid is used as an example.

The IBA is dissolved in approximately 700 ml. of 70% isopropyl alcohol and the remaining 70 ml. is used to carefully rinse the IBA container. The rinse is added to the IBA solution. To this solution is added 230 ml. distilled water, and again the mixture is shaken well.

These processes would apply as well to the incorporation of indoleacetic acid (IAA), naphthaleneacetic acid (NAA) (4), Benlate (5), Captan, boric acid, 2-(2,4,5-trichlorophenoxy) propionic acid, etc. Although 2,4,5-TP is used primarily as an herbicide, very minute quantities have been used in rooting compounds.

Obviously, now, a mixture of 1 part (500 ml.) of 2% IBA solution and 1 part (500 ml.) of 50% alcohol will give 1000 ml. of 1% IBA solution. A further 1:1 reduction of this would give 0.5% IBA and a further 1:1 reduction of this would give a 0.25% IBA solution.

Here, again, is the "rhododendron formula", this time to be prepared as a concentrated dip. The mixture produces a solution the consistency of milk; and if shaken often while using, it is quite acceptable.

To make 1 liter (1,000 ml.) of 1% IBA with 5% Benlate and 50 ppm boric acid

Add 10 gms. IBA to 770 ml. 70% isopropyl alcohol

Add 50 mg. boric acid (USP)

Add 100 gms. Benlate

Mix well and add 230 ml. distilled water.

Each stock solution of a given concentration should be stored in a well-marked container; a milk jug or anti-freeze jug serves well. The solutions should be sealed and refrigerated when not in use. A smaller container (a pint bottle serves well), is used to hold the stock solution to be used. A wide mouth plastic medicine bottle is used to hold the solution into which the cuttings are dipped. The solution from this container should never be returned to stock solution bottles. This is to prevent contamination of the stock solution or accidental mixing of different concentrations of stock solution. Another simple step to be taken to prevent accidental mixing is the addition of vegetable food dyes of different colors to different concentrations of different mixtures. This greatly facilitates the use of several solutions during a given period by unskilled workers.

My first dramatic experience in comparing results given by different concentrations on a specific crop involved *Acer palmatum* 'Atropurpureum'. We were using 0.8% and 2% IBA in talc and could only get very long single or double roots from the very base of the cutting, even with heavy wounding. These, of course, broke off easily during handling or potting. We tried a quick dip of 0.5% IBA, 1% IBA and 2% IBA in alcohol, and found that 2% IBA would stimulate good root initiation all along the stem of the cutting.

As Wain (6) has pointed out, the concentration of hormone or hormone-type substances which most actively produces roots is that concentration closest to the toxic level. I have noticed that concentrations which produce good adventitious root initiation will often burn and kill the plant tissue at the very base of the cutting, but will produce a superior root system just above this area. Conversely, it has been my experience that a concentration too low will sometimes produce a large callus formation with very few adventitious roots initiated. When the concentration is correct, we have very little callus but strong roots. We feel that hormone concentration affects callus formation more than the water level in the medium.

Whalley (7) indicates that the addition of 2-(2,4,5-trichlorophenoxy) propionic acid (2,4,5-TP) at low concentrations (0.1 ppm) will reduce auxin burn and will, therefore, let us use higher concentrations of rooting hormones on difficult plants. Our actual procedure includes wounding as well as a dip into Benlate, Clorox, or other fungicides. The cuttings should be drained before dipping in hormone in order to avoid dilution of the material. We feel wounding increases the absorptive surface of the cutting.

There is still much to be learned about the effects of different combinations and different strengths of rooting hormones on the plants being rooted.

These simple procedures will afford you the convenience of having on hand a wide range of combinations and concentrations of rooting hormones.

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COSTING AS A MOTIVATIONAL TOOL

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Can costs be effectively tracked in the nursery business? How can tracking costs help you on an everyday basis? How often do you take a look at costs? How about your supervisors? Why budget? Who creates your budget?

These are some questions I want to deal with here today. I have had the privilege of working side by side for the past two years with a CPA. He has devoted the last 8 years to developing and refining a cost accounting system that is simple enough to give daily information in running a nursery business and motivating supervisors in a positive way.

At American Garden Cole, budgeting and reporting are a way of life. If no useful benefit comes from this effort at the branch level and by the people reporting, this becomes a burdensome task.

American Garden Cole (Hamilton) is a container growing facility that has been developing over the past five years. The *motivational* aspect of costing actually begins with the preparing of a budget for the next fiscal year. Our budget is prepared by the people actually responsible for the work. For example, the pesticide budget is prepared by the man in charge of all spraying, the herbicide budget by the man in charge of weed control. Labor is budgeted by comparing past performance and looking at new methods and changes in procedures. With all these "numbers" in and budget approved, we begin to track our costs on a daily or weekly basis and compare with what we said we would do.

Now of course, you have other benefits from budgeting, too. For example, cash flow requirements are easily determined. But