POT CULTURE TESTS AS A NURSERY TOOL

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To begin with I would like to stress the point that pot cultures can be a nursery tool. As a tool they should be used to support a hypothesis or data obtained from chemical analyses (soils, tissues, etc.) Then, as pot culture conditions are usually not representative of field environment, pilot tests in the field should be set up based on information accumulated from chemical analyses and pot cultures.

Pot cultures can be most helpful to enlarge on, or clarify studies of growth, soil fertility, and insect and disease problems. However, if you apply the results of pot culture tests directly to the field on a regular production basis, disaster can sometimes occur.

Although pot cultures for growth and insect and disease studies are important, I believe there is probably more interest here in their use for soil fertility studies. Therefore, I'll limit my remarks to the latter use.

First, one must decide what you are trying to accomplish with these tests. Do you wish to find out what certain physical or chemical additives and/or different rate of same will do to soil fertility and hence the seedling growth? This is the case most times, and for this you will want to start with representative samples of the soil in question. Or do you wish to find out what one element or combination of elements, will do to seedling growth (excluding all other elements)? Here you would want to start with a sterile medium. This type of pot culture test is going more toward the basic research approach; and although we certainly need this , I don't believe there is much money or time available to do a great deal in this area at present.

Therefore, as pot cultures starting with a representative soil are the ones that we will probably be most concerned with, let me go into detail on these. One of the most, if not the most important factor in these pot cultures is a representative soil sample for the pots . All I can say is that you can only do your best here in attempting to get the proper area and depth of soil with which you are concerned. Soil varies so much area to area, that to get a truly representative sample is difficult if not impossible. However, with care and by not attempting to cover too large an area, some reasonable results can be expected in this direction.

When you are setting up the goals of the pot culture tests, keep in mind that the tests should be kept as simple as possible. Try as few treatments as you possibly can; because to be of value the tests should have at least three replicates per treatment. And I need not remind you that the more treatments, the more money and time involved, and the more chance of errors creeping in. The treatments used in these tests should be based on laboratory soils and/or tissue analyses and an appraisal of what your field problem is.

This appraisal is not easy because so little is known about the elements in the soil, their interactions and their effect on tree seedlings . Too often recommendations have been given on the basis of agricultural experience and there have been unfortunate results. For instance, a chlorosis shows up on some seedlings; is it a nitrogen deficiency, an iron deficiency, or an excess of arsenic etc.? This is why the soil and tissue analyses are important when setting up pot cultures. They may allow you to eliminate trials with some elements and reduce the number of treatments to be tested.

Perhaps your problem is not one of chlorosis or stunting. Perhaps on the whole your seedlings look good, but you feel by adjusting soil treatments you can get better caliper or a better root system. Here again pot cultures with soil and tissue tests can give you indications as to which treatment might be best. But again, let me caution you that after the pot cultures, try the treatments that show promise on small areas before using them in regular routine.

Now , I would like to suggest how to set up the pot culture tests. First a question; should you start from the seed or plant seedlings in the pot? Here it depends on what your problem is, the time you can afford to spend, and the results you hope to attain. For example, if you wish to evaluate the effect of different chemical additives on the improvement of soil fertility, I would suggest you start from seed inthe pots. Use elm, catalpa, or tomato seed. These have little food storage capacity in the seed and will give you a quick response to the different treatments. But here you may say that these are not the species you are growing so why use them. My answer would be that we are only interested, in this case, in indications as to which treatments suit our problem. You can then use the promising treatments on pilot tests with the species you are concerned with. I'd rather use this method for pot cultures concerned with this type of problem than use conifer seedlings started from seed or to plant conifer seedlings in the pots. The conifers do not usually give a quick enough response to treatments and effects of treatments are more difficult to see than they are on elm, catalpa, or tomato plants .

The next step in setting up pot cultures is to decide on the types and number of treatments you wish to use. These proposed treatments should be based on soil and/or tissue analyses. At this point you must consider that for each treatment you should have several replicates. I usually prefer 3 replicates, but let me say that anything is better than just one replicate. If something should go wrong (in your estimation) when there is only one replicate, you never have a chance of knowing whether this is a normal result or whether this is a one in a million happening.

Various type of pots can be used. Stoneware two-gallon crocks are quite good. However, plastic pots are also suitable. Keep in mind that metal pots are not to be used as the metal can give you some reactions you may not want. When speaking of the type of pots, it is also necessary to talk about drainage. If the stoneware crocks are used, they should be filled on the bottom with about a 1" layer of limestone free crushed stone. If plastic pots with drainage holes in the bottom are used they should be placed on a surface where there will be no possibility of drawing up water from a medium that might be contaminated and effect the pot treatments.

To eliminate the effects of soil moisture as a factor in the experiment, the soil in all pots should be maintained at the same moisture content. The moisture content of the pots probably will be most satisfactory if kept at a point 1/2 to 3/4 of the way from the wilting point (point at which plants wilt and do not recover) to the field capacity (amount of water held in the soil after 24 hours of drainage). Therefore, the wilting point and field capacity of the soils to be used in the pot cultures should be known. Watering should be from the bottom of the pots. If crocks are used, a glass tube can be inserted in the soil down to the crushed stone layer. This layer then acts as a reservoir and also as a drain. If plastic pots with drain holes are used, then the pots should be placed in dish type reservoirs and water added to these dishes. The moisture content can be maintained by 1) using a known amount of soil in each pot, 2) calculating the weight of the soil for a particular moisture content, 3) adding the weight of the pot, stone, and tubing and 4) weighing the whole pot frequently and adding water to bring the soil up to the desired moisture content. (predetermined weight) .

The addition of materials to be used for each treatment can be accomplished as follows; 1) weigh out enough soil for the proper number of replicates to be used for a particular treatment, 2) mix in the treatment materials for all replicates to the total amount of soil for that treatment, and 3) divide the total amount of soil into the correct amount for each pot; attempt to make each pot a truly representative sample of the whole mix.

The next step is to sow the seed of the species you wish to use (if you are starting from seed). It is usually best to sow a greater amount of seed than normally needed for a desired density. Then, after danger of damping off is over, the seedlings can be thinned to the proper density. I prefer not to use any damping off preventative fungicides as this just brings another chemical into the picture which could effect the chemicals used in the treatments .

After the seedlings have reached the desired growth for an analysis, some methods of measuring the effectiveness of treatments must be used. I have used the following means of measuring the results of treatments:

1. Needle or leaf color (or other visual observations such as needle or leaf texture, straightness of stem, etc.)

2. Shoot height.

3. Weight of total seedlings (dry at 70 °C. for 24 hours in forced draft oven before weighing). The weight of shoots and roots can be determined separately but this is quite time consuming. However, it may be necessary for some treatments.

4. Caliper of the stem (I usually use 1/4" above root collar as my measuring point).

Tissue analyses can also be used to measure treatment effect. However, the rule of thumb I use here is that if the above four measures show a definite trend I do not need tissue analyses. In other words, use the costly tissue analyses to measure treatment effect only when absolutely necessary.

Keep in mind that pot culture results may not always agree with soil and tissue analyses and/or field pilot tests. This can occur because of the complexity of the soil, sampling errors, controlled vs uncontrolled conditions, and the fact that man is only human. It is necessary sometimes to do over a series of pot cultures if there doesn't seem to be any rhyme or reason for the results that are obtained. This does n't happen often, but it does occur.

If pot cultures are to be useful, money and time must be expended. The value of pot cultures is often in direct propertion to the time spent on them. Records are very important in this work, and a good deal of time should be expended on evaluation of results before pilot tests are conducted in the field.

I have not delved deeply into many of the aspects of pot culture work. However, I hope that I have presented enough information to make two points clear, (1) to have pot cultures mean something, time and effort must be given to the project, and (2) pot cultures should be used in conjunction with soil analyses, tissue analyses, and pilot tests.