advantages of tissue culture, such as:

1. Uniformity
2. Programming of crops
3. In some species, better plant branching resulting in better products
4. Disease-free plants
5. Availability

Our goal should be for quality, efficiency, and customer satisfaction. Tissue culture is a useful technique for propagation in the horticulture industry and should not be blamed for the subsequent mishandling by producers and growers.

QUESTION BOX

Moderated by Carl Whitcomb and Bryson James

JOE POWELL: David, do you use lime in your propagation mix?

DAVID SABALKA: No. As Carl Whitcomb has pointed out, we can pick up all we need from other sources, such as water.

RICHARD ODOM: Have you tried rooting using Micromax, but no Osmocote?

CARL WHITCOMB: Yes. However, I do not recommend using Micromax unless you also use at least 4 lb. Osmocote 18-6-12/yd.^{3} Start out at the low rate. Also, be careful about mixing large batches as Osmocote may begin to release. We have found supression of rooting when most other fertilizers or formulations of Osmocote were tried and therefore use only 18-6-12 Osmocote.

RICHARD ODOM: When do you begin to see trouble from Osmocote if the rate or application method has been wrong?

DAVID SABALKA: It depends on the watering and soil temperature. We don't ordinarily have problems in the winter. Most of the time toxicity problems will show up within the first four to six weeks.

JIM BERRY: What is a dangerous salts level?

BRYSON JAMES: If the mix is 2:1 bark:perlite, no fertilizer is needed at first; 18-6-12 Osmocote doesn't release for about three to four weeks, which is about right. A salts level higher than one micromho is too high in a 2:1 mix. There are many methods of testing and expressing soluble salts concentrations. It is important to use one method consistently and monitor changes. Once you determine the level at which your plants do best, that level can be used as a guide for making needed adjustments in fertilizer pro-

grams from time to time.

GARY TAYLOR: Do you use wetting agents in the mix?

DAVID SABALKA: Yes, but they are expensive. I prefer to avoid them if possible.

BRYSON JAMES: It is better to change the medium or the mist cycle than to depend on wetting agents.

CARL WHITCOMB: When David was describing his mixes, I thought, "Remember, his material is a particular combination of particle size, which will change the air space even though the ingredients and their ratio may be the same as that of some other propagator." Drainage depends on the depth of the pot and the physical characteristics of the medium. When the same growing medium is placed in containers of varying depth, as the container depth decreases, the proportion of well-drained growing medium also decreases.

DAVID JOHNSON: Will it matter what the container is sitting on?

CARL WHITCOMB: If there is any break between the medium in the container and the material on which it is sitting, the effects of particle size of the mix and pot depth will the the same as just described. If you use a capillary mat and get good contact, you can actually pull out excess water. The problem is that the roots will grow into the material. A small particle-size material below the container will pull out water better than a coarse one. The simplest thing to recommend to a person having trouble is to use a deeper pot. In all cases, of course, you must have a mix that does not fall apart during transplanting because of too much pore space. The material should remain with the roots when the plant is transplanted.

BRYSON JAMES: Don't make too big a handle on the cutting by removing bottom leaves. The propagators then tend to stick the cuttings too deep where they are in the saturated soil zone of the container.

CHARLES COX: What is wrong with pure bark for a rooting medium?

CARL WHITCOMB: It is often used. In my own case, I just don't get as good subsequent growth.

DAVID SABALKA: We find we can grow in 100 percent pine bark, but the plant often has trouble in the landscape later.

CHARLIE PARKERSON: Ted Richardson grows only in bark.

TED RICHARDSON: I have been using pure bark for 15 years and have found nothing to improve it. I seem not to have much control over the man loading the dump truck. I say I want ½-in. screen, but probably ¾-in. is just as good.

JOE POWELL: Fine bark did not work for us, but a coarser grade was also unsatisfactory. However, when we added a little sand, it worked quite well.

CHARLES COX: What about sand?

BRYSON JAMES: Straight pure sand is fine if it is clean. Particle size is important. The question is what you are going to do with the liner. It is best to have the rooting medium as nearly as possible like what it will eventually be growing in. Often sand is added just to keep containers from blowing over. Frank Pokorny, University of Georgia, has done a great deal of research on particle size of pine bark and would be glad to send you a list of his papers. I have better luck adding some other material to improve drainage. I recommend that pine bark be ¾-in. particle size and smaller.

MICHAEL DIRR: What about root cubes? We have used them and had no interface problems.

TED RICHARDSON: We have found that if you plant a cutting in a root cube and don't give the cutting specific aftercare, there will always be an interface.

DAVID BYERS: Unless the roots are clear out of the cube, the cutting has trouble surviving. The cube often dries out while is it impossible for the plant to pick up water from the surrounding medium.

PETER VAN DER GIESSEN: The most important of all is the cutting itself and how deep it is stuck.

CHARLIE PARKERSON: Is blending Osmocote into the propagation mix a problem? We have been top dressing for fear we do not get an even distribution when we mix it in.

CARL WHITCOMB: We prefer incorporation to avoid algae growth on top of containers.

GARY TAYLOR: Cariedda, how often does your fog come on?

CARIEDDA HUDGENS: When the temperature outside is 90°F., the fog stays on almost all day. As the days get shorter, the time of day when it turns on and off are later and earlier. With our fog nozzles 7 feet above the plants, in summer it goes off perhaps five times a day.

QUESTION TO MICHAEL DIRR: Does it matter whether you take cuttings from stock or sales plants?

MICHAEL DIRR: Sales plants are usually too high in nitrogen, which makes the carbohydrate balance not the best for rooting.

BRYSON JAMES: There are also other factors involved. Someone from Greenleaf Nursery has said they have found cuttings were weaker as they were taken from plants farther removed from the original parent.

RANDY DAVIS: *Prunus* species will not root for us when taken from our sales plants. We get 2 percent rooting of the cuttings taken from sales plants but 95 percent of those taken from stock plants.

QUESTION FOR MICHAEL DIRR: We get heavy callus and no roots on Raphiolepis, Cleyera, and Photinia cuttings. What do you suggest?

MICHAEL DIRR: Increase the hormone level and watch your watering.

BILL BARR: We use 25000 ppm IBA and 2500 ppm NAA for *Raphiolepis;* 10,000 ppm IBA for *Photinia,* but no hormone for *Cleyera. Cleyera* takes 6 to 9 months to root, however. Our mix is 50 percent bark, 25 percent peat, and 25 percent sand.

There was also a question earlier as to the time to stick dwarf yaupon holly. We stick cuttings in December, January, and February and mist lightly. We use only a light hormone treatment.

MARK HOUSE: We have noticed leaf burn on cuttings of dwarf yaupon cultivars when we used IBA in alcohol. We now use K-IBA and take cuttings in May and June and get 85 percent rooting.

BILL BARR: We use bottom heat, a perlite medium and 1800 ppm IBA. We get 80 to 90 percent rooting. We have found no burn from K-IBA.

JUDSON GERMANY: Probably the cuttings of yaupon holly could be taken just about any month. I believe the trouble is sticking too deeply and using too much water.

JIM BERRY: We find the optimum time to take cuttings is in October when the summer heat breaks and we can stick cuttings in the greenhouse. We use 1875 ppm IBA in alcohol although I actually like to use 3000 ppm in water. The caliper of the cutting is important. We use a bushy cutting and leave a branch ¾ inch from the bottom. This keeps the propagators from sticking the cuttings too deep.

DON COVAN: Has anyone else had a problem with Rout ornamental herbicide? We have noticed an effect on crape myrtle, photinia, and dogwood.

RICHARD ODOM: We were concerned about using Rout and talked with company representatives who said it is not economically feasible for them to do the research on each ornamental species. If enough growers contact the company requesting it, they will do the research.

CARL WHITCOMB: I believe it is the Surflan in the Rout that is causing the trouble.

RICHARD ODOM: The company researcher said that the Surflan is much more soluble than Goal and that because of this it is a volume, or concentration, effect. These people say that as long as the plant is well-established, Rout is safe.

CHARLES GILLIAM: Both Scotts and Sierra have removed crape myrtle from the label and are testing Surflan. I have found that Surflan definitely affects rooting of Japanese holly. Helleri holly is back on the label this year, however.

BRYSON JAMES: Has anyone had problems with Truban?

GARY TAYLOR: We didn't get any rooting in our rhododendrons when we used Truban.

TED RICHARDSON: In answer to a question about using Alliette fungicide I would say that it is more or less all right to use although I have not done any real testing.

TED GOREAU: We have used Alliette for about a year with mixed results. I have not felt it was especially effective in controlling *Rhizoctonia*. It seemed to me that azaleas did not do well after using Alliette on them. I think a good basic fungicide program is important.

JIM BERRY: We use primarily Benlate and Zyban fungicides and Orthene insecticide in our basic program.

CHARLIE PARKERSON: Last year at this meeting we discussed the problem of azaleas breaking off at the soil line. It seems to be a physiological problem, perhaps just the result of creased roots in the bottom of the container. We noticed the problem long before we began using many of these chemicals, so I don't think we can blame them. It may be just a series of other factors. Maybe cold weather almost, but not quite, causes bark split. The problem is industry-wide. Some cultivars are more susceptible, but none are completely immune. It does seem to move through a planting. As yet there aren't any answers.

CARL WHITCOMB: I have been asked about using concrete above heating pipes in order to even out the distribution of bottom heat. It has been reported that the concrete really did not help that much.

CHARLIE PARKERSON: We find that the porous concrete works much better.

MICHAEL RICHARD: We have 4 inches of concrete over our heating pipes and are getting even distribution. We are using 100° to 120°F water.

STEVE NEWMAN: I have been asked whether or not plants feel wind chill in the same way as humans. They do not. However, they do desiccate because of the wind.

CARL WHITCOMB: Wind around containers removes heat, of course.

CHARLIE PARKERSON: There was a question about the effect of white rock or white poly ground cover under the pots. White on the ground will increase heat around the container but the white container will keep the plant roots cooler.

CARL WHITCOMB: There has been a question as to how long plants can grow in the field in the fabric containers. It depends on the plant itself. Eventually the restricted root growth will restrict top growth as well.

BRYSON JAMES: How long you keep it in the field will depend on the market. I agree with Carl that the restriction is no greater than it would be in a pot.

GARY TAYLOR: Is foliar feeding effective?

BRYSON JAMES: It is mainly useful for stimulating plant

growth in the short term. It is not good for an all-around method of applying fertilizer.

DAVID JOHNSON: We are finding high pH readings in pine bark. We have high mounds of bark that are not really ageing, so are developing some toxicity.

CHARLIE PARKERSON: We threw away our pH meter. As long as the Ca:Mg ratio is okay, pH seems not to matter. I don't believe high pH itself is the problem; high pH is just an indicator that something else may be wrong.