

valves in an average nursery can do more than any other single innovation to improve quality and reduce problems in growing plants in containers.

I have observed that there are stages in the production cycle when there are variations in water needs or stages when growers tend to misjudge water requirements. These are as follows:

1. *Immediately after sticking cuttings* — Excessive misting does not appear to be a major problem at this early stage in propagation. Adequate mist, on the other hand, is critical for survival of the cutting at this stage.
2. *After roots have formed on the cuttings* — Failure to gradually reduce the mist applied at this stage is a major cause of root deterioration.
3. *During over-wintering of liners in plastic structures* — Reduced air movement, lower temperatures, low light, and high humidity greatly reduce both leaf transpiration and evaporation of water from the soil in enclosed structures. Frequent water applications under these conditions can cause a disastrous decline in the root system.
4. *Immediately after canning* — Many plants are stressed due to canning into dry mixes that are extremely difficult to re-wet. Other problems have been observed when liners growing in a dry mix are canned into a moist mix. Failure of the water to penetrate into the liner mix at the first watering is a common occurrence in this situation. There is also a tendency to keep recently-canned liners too wet for the first 6 to 8 weeks. This reduces the soil oxygen levels and retards root growth and also predisposes the roots to heavy infestations from soil disease organisms. On the other hand, care is necessary to water when needed since the roots are occupying a small soil volume with a limited water reserve at this stage.
5. *Stage approaching maturity* — At this stage it is much more difficult to create problems during the growing season by too frequent water applications since leaf transpiration is removing the soil water at a rapid rate. Excessive drying at this stage creates stress conditions that often result in an end to accelerated top growth. Also at this stage, a high percentage of the pore spaces are now occupied by roots, thus reducing the water-holding capacity of the mix.

QUESTION BOX

The Question Box was moderated by Carl Whitcomb, Oklahoma State University, Stillwater, Oklahoma.

TED RICHARDSON: Carl, I would like to know more about the pot you developed that has slits in the sides.

CARL WHITCOMB: The roots are air-pruned when they reach the slits, which leads to the branching. In fact, we believe this container may even encourage top branching in some plants. We have no explanation, but the container is the only different factor used in production of the plants that were better branched. They have been costly to manufacture, but we are now working with Lerio and believe they have a method that will make it possible to manufacture the pot economically.

JOSÉ GARCIA: Does anyone have a method for effective mole control?

BRYSON JAMES: If you eliminate grubs, the moles will likely disappear.

GERALD VERKADE: Can *Acer griseum* be propagated from cuttings?

MRS. BEN PERRY: I have propagated it using a peat:sand medium. I took the cuttings in May.

CARL WHITCOMB: It roots reasonably well using softwood cuttings under mist; 8000 ppm IBA in talc helps. They do not do much growing until the second year.

BILL BEATY: Would the rooting chamber used in air rooting need to be dark?

CARL WHITCOMB: There are reports in the literature that light inhibits rooting. However, cuttings of some plants root in a clear glass of water.

BRYSON JAMES: Why not root peaches right in the ground? It can be done rather easily.

CARL WHITCOMB: The main advantage to air rooting is improved oxygen availability.

BILL BEATY: What is your recommendation for converting propagation to the wet tent method?

CARL WHITCOMB: It is not the answer to all propagation problems but may be very helpful on real toughies. Bob Hartline suggested using a mist nozzle to keep the fabric wet and I have been told Hercules makes a fabric called Herculon that might be good. Jim Berry, Mobile, Alabama, pointed out that a different climatic environment could greatly affect success. Bryson James mentioned the importance of water quality to avoid salts build up that would affect wicking.

CARL WHITCOMB: Bon Hartline, Ana, Illinois, has brought specimens of *Ilex decidua* cultivars that would be

good plants for the U.S. Southern Region. Bon will tell us something about them.

BON HARTLINE: The common name of *Ilex decidua* is possum haw. There is also a deciduous holly, *I. longipes*, that has stalked berries. I've heard these hold the berries well. Joe McDaniel, Urbana, Illinois, and I have selected and named several from the deciduous species. Byers Nursery has a golden form, but it is difficult to propagate. Bob Simpson, Vincennes, Indiana, has also introduced several hybrids. These deciduous hollies are hardy to zone 5. They are not pH sensitive and can survive flooding. Mature *I. decidua* plants are about 20 ft tall; *I. verticillata* plants are 6 to 7 ft. There is some tendency towards alternate bearing, but it is not a serious problem.

JIM BERRY: They can be found clear to the Gulf. I've seen pink, orange and red forms. Berries persist on some trees until March, then the birds may clean the trees in one day. Would you tell us more about propagation?

BON HARTLINE: At first we used the same procedure we do with *I. opaca*, which we propagate from July to March. The cuttings looked good but did not root. We now take cuttings as soon as frost hits in the fall.

CHARLIE PARKERSON: I'd like to discuss winter protection. We are using a system that seems to work and it may be of interest to others. We lay opaque copolymer plastic on the plants, then cover with Saran so that we have about 78% shade. The plants haven't been crushed nor have we had a significant heat build-up. We have not even laid the plants down. We formerly waited until after a rain and then punched small holes in any low spots so that the water could drain through. We now drill small holes in the roll of plastic before laying it, which is much less time consuming. We do not have black plastic under the containers, so drainage has not been a problem. What we are trying to do is avoid the expense of building frames. Labor costs are also reduced.

FLETCHER FLEMER: What is the best source for a seed cleaner?

DAVID BYERS: We use Bouldin-Lawson equipment. We buy seed and prefer to buy from local collectors who know the area. We like to have it gathered just as the pulp begins to soften. We believe we get better germination when the pulp is removed although Bill Dutcher has said he found little differences.

BILL DUTCHER: I'll like more information on callusing. Why do we get excessive callusing?

BRYSON JAMES: It is associated with poor aeration.

CARL WHITCOMB: Too high auxin concentration can cause callusing also. The season in which the cutting is taken also affects the formation of callus. Also, response may be different from one year to the next. There are reports that increased auxin may help one year but not the next on rhododendrons. Callus is formed in a different area than are the new roots.

DOUCHER: Does callus take up moisture?

CARL WHITCOMB: I have no direct evidence but believe that it does.

JIM BERRY: I have found on *Photinia* that with inadequate levels of auxin we get callus formation. I believe the plants are under stress and that fertilizing helps.

TED BECKETT: Decreasing the water is critical. We treat a callused cutting just as if it were rooted.

SHIVU PATEL: I believe there is a difference in *Photinia* rooting between the red new growth and mature green-leaved material.

CARROLL HALL: We get 95% rooting using high-humidity propagation, which, of course, helps reduce soil water content.

GERALD SMITH: Some of the speakers have indicated they rinse cuttings with Benlate¹. Does it inhibit rooting?

ROBERT LAMBE: John McGuire² found better rooting when he used Benlate. Truban³, however, may inhibit rooting, but using a drench with the 5G formulation improved rooting.

DAVID MORGAN: We have just finished a study of the effect of 22 different fungicides on rooting. We found no inhibition from either the drench or soil incorporation with most of the materials. However, Lesan⁴ used as a soak did lead to a slight decrease. Each plant would need to be tested separately.

CARROLL HALL: We soak cuttings 5 to 10 minutes in Benlate at the concentration recommended for spray and have observed no inhibition.

BILL DAUGHTRY: Related to the use of fungicides is the importance of using clean water. We inject chlorine using equipment manufactured by Pennwalt, 25 Main Street, Belleville, NJ. We have found their series B 500 remote vacuum chlorinator to be our best choice. It is, we think, the safest.

¹ Benlate — benomyl, duPont

² Dr. John J. McGuire, Department of Plant and Soil Science, University of Rhode Island, Kingston, Rhode Island 02881.

³ Truban — Ethazol, Mallinckrodt

⁴ Lesan — Dexon, fenaminosulf

The chlorine is injected between the water reservoir and the pump with the result that we are actually chlorinating a small volume of water in the reservoir right at the pump intake. The fertilizers injected at the pump tend to inactivate the chlorine so there is little pathogen exposure time to the treatment. We lengthen that time by injecting the chlorine as long as possible before the water reaches the pump. We try to maintain a concentration of 0.3 ppm Cl as measured with swimming pool equipment. Dry material costs \$1/lb and is only 65% Cl while the cylinders of gas costs \$0.23/lb and are 100% Cl. We use about 400 lb of the gas per pump annually as 90% of our water drains back into the pond, and we do recirculate it. We felt treatment was essential, but treating the entire pond is cost prohibitive. Subdue* will suppress but not kill the water mold fungi. Robert Lambe points out that we don't know about development of resistance to Subdue and says chlorine is probably the best control. However, chlorine affects fungi with mobile spores and does little to control others. It is important to test continuously and keep up the sanitation program.

TED RICHARDSON: At the Research Station in Boskoop, The Netherlands, the water goes into the canal with *Phytophthora* but comes out without it.

CARL WHITCOMB: The same thing is true in Australia. . . . Actually, research indicates that if other growing conditions are optimum and plants are healthy, we can have high levels of fungi in the water without damage. It is also true that water will often clear up, probably due to aeration and to the action of other microorganisms.

ED KINSEY: We find methyl bromide is cost effective for use on pots.

ROBERT LAMBE: It does not have the penetrating action on pots that it does on soil, and it is difficult to get good control. I would recommend washing with a chlorine solution instead.

* Subdue — Metalaxyl (CIBA-GEIGY)