Subirrigation of Rhododendron as an Alternative to Mist

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The success of softwood or semihardwood stem cutting propagation requires optimal conditions of the plant and the rooting environment, such that new roots may be initiated on a severed stem. Perhaps most important in the rooting process is the control of water loss. If water loss from the cutting exceeds the ability of the stem to take up water, either through the leaves or cutting base, it will experience water stress, and may die. In either case rooting success is greatly reduced or prevented altogether. The development of intermittent mist in the early 1950s was a great aid to plant propagators (Hartmann et al., 1997). The mist reduces transpiration stress by cooling the leaf surface, and reduces evaporation of water from the leaf. However, mist propagation is not without its problems. Mist has been shown to promote leaf chlorosis, mineral nutrient leaching, necrosis, and algal growth (Hartmann et al., 1997). As well, the propagator must be vigilant against waterlogging of the rooting medium, salt build-up or clogged nozzles, and other maintenance requirements. Fog may be a promising alternative to intermittent mist for stem cutting propagation because it does not lead to many of the problems associated with intermittent mist. Unfortunately fog is comparatively expensive to install, and also requires regular maintenance (Hartmann et al., 1997).

The use of subirrigation technology has been proposed as an inexpensive substitute to intermittent mist for softwood and semihardwood stem cutting propagation (Mezitt, 1978; Zhang and Graves, 1995; Cuny, 1996). In subirrigation, stem cuttings are inserted into perforated propagation flats filled with perlite. These propagation flats are placed in a reservoir of water, with the water level maintained about 1 inch (2.4 cm) below the base of the cuttings. Water moves through the rooting medium from the reservoir to the cutting base by capillary action. This method of propagation keeps the leaf surface of the cutting dry, thereby reducing disease and nutrient leaching, and requires no automated equipment.

A key to the success of subirrigation seems to be the use of perlite as the rooting medium (Mezitt, 1978; Zhang and Graves, 1995). Historically, perlite, produced from crushed aluminum-silica volcanic rock, has been used as an amendment to propagation media because it increases drainage and aeration (Dirr and Heuser, 1987). Though perlite is essentially inert and has no cation exchange capacity or nutritional value, each particle of perlite contains micropores that make excellent capillary channels. The capillarity of perlite exceeds that of most other rooting media, including sand (Cooke and Dunsby, 1978; Moore, 1987). Cuttings also benefit from the ease in which they are able to take up water contained in perlite, that does not bind water as tightly as other propagation media, such as peat which is highly organic and contains negative charges that attract water. It is intriguing that perlite holds very little water (3 to 4 times dry weight), but readily passes it to the cutting, while peat, which holds lots of water (up to 15 times dry weight), actually makes less water available to the cutting (Grange and Loach, 1983).

Subirrigation has been used successfully to propagate a range of species by stem cuttings including *Acer, Berberis, Betula, Cornus, Cotinus, Hamamelis, Magnolia, Prunus, Syringa,* and *Viburnum*, as well as many herbaceous species (Mezitt, 1978;

Zhang and Graves, 1995; Cuny, 1996). However, poor success has been reported for rooting cuttings of rhododendron by this method (Cuny, 1996). We noted that most propagation literature suggests rooting rhododendron cultivars in an acidic medium of either peat/perlite or peat/vermiculite. However, the perlite used in subirrigation systems typically runs between pH 6 to 8 (Hartmann et al., 1997) and the tap water used in the subirrigation reservoir also is usually neutral to alkaline. We suspected that the pH of the typical subirrigation system would not be optimal for rooting ericaceous plants. In the studies reported herein we investigated the effects of subirrigation and medium pH on the rooting of several rhododendron cultivars.

Terminal stem cuttings of the rhododendron cultivars P.J.M. Group, 'Purple Gem', and 'Catawbiense Album' were collected from stock blocks in early August. Cuttings were stripped to 6 or 7 leaves and the 'Catawbiense Album' leaves were trimmed in half. Cuttings were wounded on one side and treated with a 1 : 10 (v/v) aqueous dilution of Dip 'n Grow (1.0% IBA, 0.5% NAA, Astoria-Pacific, Clackamas, OR). The propagation system was set up in a greenhouse under about 90% shade. For each treatment, three replicate reservoirs were set up, each containing 1 inches of water. The first treatment used tap water (pH=7.5; lime added at the water plant to reduce pipe corrosion). The second treatment used tap water titrated to a pH of 4.5 with weak sulfuric acid. The third treatment used tap water mixed with peat moss at a 4 : 1 (v/v) ratio to form a peat slurry (pH=4.1). Perforated propagation flats filled with perlite were placed in the reservoir the day before the cuttings were inserted to allow time for the equilibration of the reservoir solution with the perlite. The cuttings were inserted into the perlite so that the base of the cutting was approximately 1 inch above the water table.

Table 1. Rooting response and root volume displacement of rhododendron cuttings rooted in a subirrigation system at two solution pH levels (rooting time 63 days), n=40 values.

	Rooting percentage			Root volume displacement (ml)		
Cultivar	pH 4.5	pH 7.5	Peat slurry	pH 4.5	pH 7.5	Peat slurry
Catawbiense Album	87.5	72.5	-	12.4	2.5	n/a
P.J.M.	85	37.5	87.5	2.8	0.8	3.9
Purple Gem	97.5	80	95	3.5	0.3	3.2

At no time were the top of the propagation flats or the cuttings misted. The solution pH was monitored weekly, and water was added to bring the subirrigation solution back to its original level. The pH of the 4.5 treatment had a tendency to rise over time, and was adjusted biweekly with weak sulfuric acid. The pH of the peat slurry was more stable and never needed to be adjusted over the course of the experiment (9 weeks). However, the peat slurry treatment was more susceptible to evaporation due to increased surface area and water had to be added more often. After several weeks the peat settled to the bottom of the reservoir and evaporation decreased.

The cuttings were harvested after 9 weeks and rooting percentages recorded along with rootball volume displacement. The solution pH of the subirrigation system had a dramatic effect on rooting of all cultivars whether pH was brought down by sulfuric acid or by peat (Table 1). It is deceiving to examine rooting percentages alone without also examining root ball displacement. Although 'Purple Gem' and 'Catawbiense Album' rooted 80% and 73%, respectively, in the pH 7.5 treatment, almost all of the rootballs were commercially unacceptable. Cuttings rooted in high percentages in the low pH treatments, and also produced root balls 5 ('Catawbiense Album') to 10 times ('P.J.M.' and 'Purple Gem') greater than in the high pH treatment. The large-leaved 'Catawbiense Album' yielded larger cuttings then the small-leaved 'P.J.M.' and 'Purple Gem' and consequentially had a larger root ball volumes.

In additional trials, we mixed peat with perlite in the propagation medium in ratios of 1 : 2 (v/v) and 1 : 4 (v/v). These mixes resulted in inferior rooting, well below 50% (data not shown). Stem rot also was apparent in most of the unrooted stems, most likely due to waterlogging of the rooting medium.

Though we were able to successfully root all three cultivars of rhododendron without intermittent mist, rooting percentages and time of root formation lagged behind that of intermittent mist. Cuttings of 'P.J.M.', 'Purple Gem', and 'Catawbiense Album' rooted at 100%, 100%, and 95%, respectfully, under intermittent mist (data not shown). These cuttings were propagated in a medium consisting of peat and perlite (1 : 2, v/v). When the root balls of the cuttings propagated under intermittent mist were gently washed, most of the peat washed away leaving only the perlite. This resulted in a root ball that could not be directly compared to that of a root ball propagated in 100% perlite. However the rootballs from the rhododendrons rooted under intermittent mist appeared to be slightly larger then those produced in subirrigation. This increase in size may be due to greater water stress experienced by subirrigated cuttings. However, for those who wish to root rhododendrons without mist, subirrigation with low pH solutions works quite well.

There may be potential in combining subirrigation with mist for hard-to-root cuttings that do not tolerate excess water on their foliage or which are susceptible to disease, salt-buildup, or leaching. Cuttings that normally need to be misted once every 8 or 16 min may require mist only once or twice an hour, or less, if subirrigation is used.

Presently, we are researching the use of sand as an alternative, or amendment, to perlite medium in subirrigation propagation. Sand is less expensive then perlite and might help promote the development of a more fibrous root system. We also are studying the grade of perlite used, and its effect on the moisture content of the rooting medium. Easy-to-root plants and plants that are considered "heavy feeders" may also benefit from subirrigation propagation. Once cuttings have formed roots, fertilizer might be added to the subirrigation reservoir to speed the growth and development of the newly rooted cuttings (Zhang and Graves, 1995). With further refinement, cutting propagation using subirrigation promises to be a viable and economical alternative to intermittent mist for the commercial cutting propagation of many plant species.

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Ericaceous Plants from Seeds

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There is undoubtedly thousands upon thousands of ericaceous plants that are grown annually from cuttings. In many cases these plants are named clones and as a part of the natural selection process the ability to root from cuttings is an integral part of the success of the plant in the market place. However, many individual species of ericaceous plants such as *Rhododendron maximum,* can only be rooted with marginal to poor results and certain plants, such as *Pieris floribunda* and wild forms of *Kalmia latifolia,* can not be rooted at all. Aside from collection from the wild the only feasible source of some *Rhododendron* species and related plants is via seed.

NURSERY PRACTICE

Several key ingredients are essential for good nursery production of ericaceous seedlings.

Of utmost importance is fresh seed. Since many ericaceous plants have seeds ranging in the neighborhood of 300,000 to the ounce the likely hood of seed degradation over time is to be expected. Dirr and Heuser (1987) suggest that seed will remain viable with a moisture level of 4% to 9% for about 2 years if kept in cold storage. However, work done at Lorax Farms has shown seed of *P. japonica* and *Leucothoe axillaris* to degradate after 1 year in cold storage. The importance of fresh seed can not be over emphasized.

Second in line to fresh seed is the need for light. Work done by Blazich et al. (1991) and Duncan and Bilderback (1982) showed that for *Rhododendron maximum, R. catawbiense, and K. latifolia* light was absolutely essential for good germination percentages. Both groups of researchers found that while a minimum photoperiod is needed for good germination (> 4 h) once this level is achieved there is an upper limit of about 12 h with little or no appreciable gain past that point. In practice it