Subirrigation Trials with Native Plants
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An article in the Summer, 2004 issue of FNN introduced the idea of using subirrigation to improve the growing of broadleaved native plants. The problem is that, under traditional sprinkler irrigation, large leaves create an "umbrella effect" that inhibits equal distribution of water from container to container or cavity to cavity in block containers. We suspect that this variation in moisture content would be reflected in uneven growth and perhaps even seedling mortality in excessively dry containers or cells.

Layout - Last summer, we conducted a subirrigation trial growing 2 native plants [blue spruce (*Picea pungens*) and pale purple coneflower (*Echinacea pallida*)] in a greenhouse at the USDA Forest Service Rocky Mountain Research Station in Moscow, Idaho. We designed an experiment using 3 different Styroblock™ containers receiving either standard overhead boom irrigation or subirrigation. Each Styroblock™ has the same outer dimensions but contains a different number of cavities. The Styro 4 has 160 cavities with a volume of 5.5 in^3 (90 cm^3); the Styro 6 has 112 cavities with a volume of 6.6 in^3 (108 cm^3); the Styro 20 has 45 cavities with a volume of 20.5 in^3 (336 cm^3). We randomly installed 3 separate, plastic Ebb-Flo subirrigation trays (Midwest GroMaster Inc, St Charles, Illinois) on top of greenhouse benches. Each tray was plumbed to a submersible pump in separate reservoir tanks under the bench. The trays were filled with water when a timer triggered the pump (Figure 1A) and, when the pump stopped, the water slowly drained back into the tanks (Figure 1B).

In late May 2005, containers were filled with a 1:1 (v:v) *Sphagnum* peat:vermiculite growing medium that contained 2.8 lb/ft^3 (3.2 kg/m^3) of Apex® 14-14-14 controlled-release fertilizer with a 3 to 4 month release rate. The 2 species x 3 container x 2 irrigation treatments were in a completely randomized design and replicated three times. Once filled with medium, each container was sown with seeds and all containers were irrigated with overhead irrigation to field capacity and weighed. As required, containers were misted with the overhead irrigation system to promote germination. After germination, seedlings were thinned to one plant per cavity and any empty cavities were noted.

Containers in all treatments were irrigated when they had dried to 85% of their wet weight. For the overhead irrigation treatments, each species by container combination was monitored separately and irrigated as needed. For the subirrigation treatments, whenever any container type required irrigation, all of the species x container combinations in that tray were irrigated. All of the treatments were also monitored for leachate volume and electrical conductivity (EC). Following each subirrigation, a subsample from the reservoir tank was removed and tested for EC and soluble nitrogen.

After the plants had grown for 3 months, final survival was measured and 5 seedlings from each species by container by irrigation combination were harvested. Spruce seedling height was measured from the groundline to the tip of the terminal; root collar diameter was measured at groundline. For coneflowers, height was defined as the longest petiole length on the plant. For both species, roots were gently washed to remove medium, and shoots and roots were separated and dried to constant weight at 140 °F (60 °C) and ovendry weight measured.

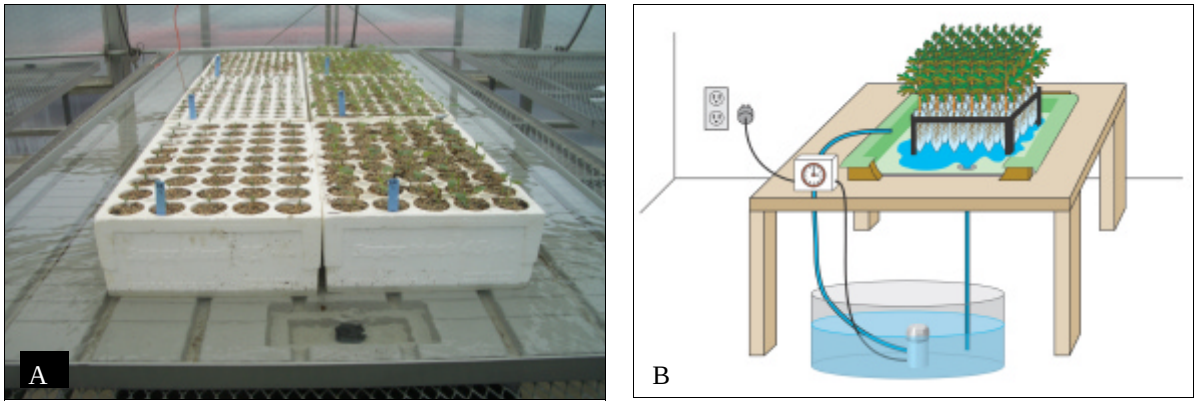


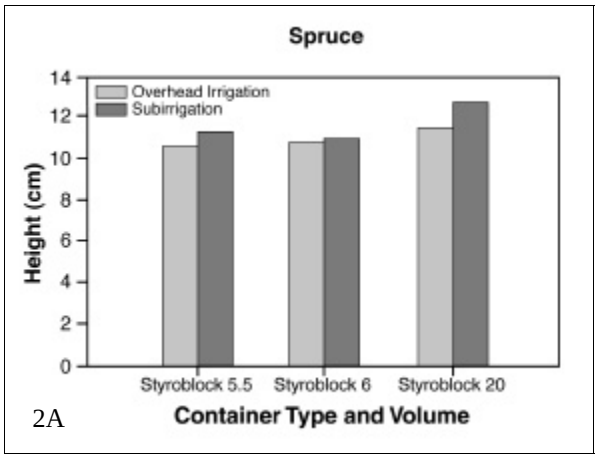
Figure 1 - Two Stryoblock™ containers of 3 different volumes and growing densities fit into each subirrigation tray (A). They filled with water when an irrigation timer started a submersible pump in a water tank below the greenhouse bench. When the irrigation timer stopped, the water slowly drained back into the tank (B).

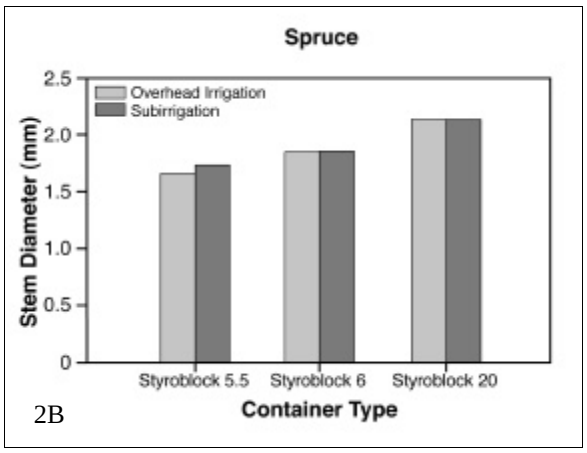
Preliminary Results - When Tom saw the plants at the end of the growing season, the first thing that impressed him was the fact that the plants in the subirrigation trays were as large as the sprinkler treatment (Figure 2A). This confirmed our first hypothesis - that native plants would grow as well under subirrigation as with traditional sprinkler irrigation. His second observation was the very uniform height and stem diameter of the spruce seedlings in the subirrigation treatment (Figure 2B). This was probably due to the fact that subirrigation supplies an equal amount of water to each cell in the Styroblock™. Perhaps the most striking observation was the irregular stocking in the coneflower plants in the sprinkler treatment. In each of the container types, more coneflower seedlings had died under sprinkler irrigation than under subirrigation (Figure 2C). Although we can't prove the cause of death, it appears that some plants had become severely moisture-stressed due to irregular water distribution between cells.

We are currently analyzing all the data and will have a final report by next summer. Other subirrigation trials are currently underway with oaks and other broadleaved tree seedlings at Purdue University and with broadleaved tropical plants at native plant nurseries in Hawaii. There are still many questions to be answered but it's obvious that subirrigation can be used to grow native plants as well as overhead sprinklers and probably with a lot less water. Because seedling foliage is kept dry, there should be fewer problems with many diseases. Another attractive benefit of subirrigation is that runoff is completely contained which has obvious benefits for eliminating potential fertilizer pollution.

References:

Landis TD, Wilkinson K. 2004. Subirrigation: A better option for broad-leaved container nursery crops? Forest Nursery Notes, Winter 2004. Portland (OR): USDA Forest Service, PNW, State and Private Forestry, R6-CP-TP-01-04.





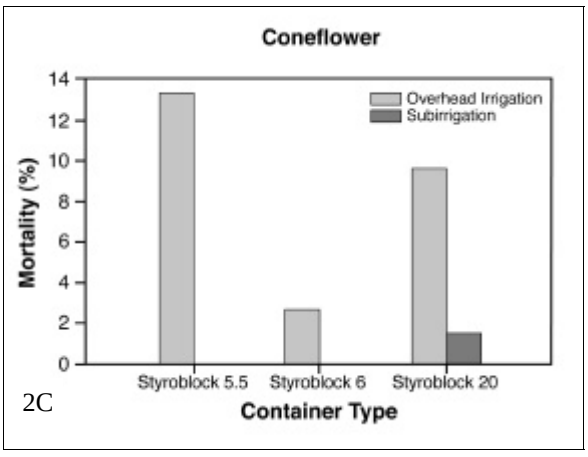


Figure 2—Spruce seedlings were slightly larger with subirrigation compared to sprinkler irrigation in all three container types (A, B). The most impressive result was that many more coneflower seedlings died under sprinkler irrigation, which supports our hypothesis that their large leaves interfered with water distribution between cells.