Effects of Cyclic Micro-Irrigation and Media on Irrigation Application Efficiency and Growth of Quercus acutissima in Pot-in-Pot Production

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Nature of Work: The quality and quantity of water used, along with the effluent leaving container nurseries, are of great concern to nurseries in the United States (9,15,17). Increasing irrigation application efficiency [((water volume applied-water volume lost)/ water volume applied) x 100] by reducing leachate volume is important from an economical and environmental standpoint. Pot-in-pot production, introduced around 1990, is where a 'socket' pot is permanently placed in the ground. A container plant is then placed inside the 'socket' pot (12). With cyclic irrigation, a plant's daily water allotment is subdivided into more than one application with prescribed intervals between applications, contrasted with conventional irrigation practices whereby the daily water allotment is applied in a single (continuous) application (5,6,11). Little research has been done on cyclic irrigation in pot-in-pot production.

Increased awareness for proper water use within an ecologically managed environment has stimulated interest in the development of improved water use techniques (3). With increasing emphasis on water quality, commercial nurseries are being targeted as a potential source of ground and surface water contamination (2). Container-grown landscape plants are usually irrigated with overhead sprinklers. Yet, overhead irrigation is inefficient, especially for larger plants (1,16). Overhead irrigation may apply 40,000 gal of water per acre daily, with losses from 40 to 90% through evaporation during application and runoff (2). Selecting irrigation systems, schedules, and growth media are major parameters affecting plant growth. A more efficient alternative to the standard practice of overhead irrigation is intermittent (cyclic) irrigation through a spray stake in each individual container (7,8). Cyclic irrigation may improve irrigation application efficiency by allowing time for water to move through the micropore system of a container substrate (4). Irrigation application efficiency was improved 38% with cycled irrigation over one time applications (14). Growers that use cyclic irrigation can expect greater plant utilization of applied N as well as reduced water and nutrient loss from containers (4). Few nurseries monitor evapotranspiration or moisture levels of the growing medium to determine plant water requirements and increase irrigation efficiency. Applying irrigation based on daily water loss (DWL= plant transpiration plus evaporative loss from substrate) from the container may further improve irrigation application efficiency (13).

The goals of this project were to determine if cyclic micro-irrigation and pinebark medium amended with coconut coir effectively reduce the leachate volume leaving containers and improve irrigation application efficiency. Media and irrigation were evaluated for their effects on growth of *Quercus acutissima*, in a pot-in-pot production system.

Eighteen to 24" bare root trees were planted in 15 gallon "GripLip" containers (Nursery Supplies of Fairless Hills, PA) in April 1996. Two media were used, 100 percent pinebark and 80/20 pinebark/coconut coir. Both media were amended with 6 pounds per cubic yard of dolomitic limestone. Trees were topdressed with either 6.3 or 12.6 ounces of controlled release fertilizer (Sierra 17-6-10 plus minors). Initial height and caliper were taken after the 96 trees were planted and final measurements in September, 1996. Above ground insulated plywood boxes were built and insulated to simulate a pot-in-pot environment. A hole was cut in the top of the box for container placement and an access door was built to collect leachates. Six trees representing each irrigation and media treatment were placed in the above ground model pots. Containers were saturated, allowed to drain then weighed to determine weight at the maximum water holding level or "container capacity". Weights were then taken prior to an irrigation event to determine pre-irrigation container water level. The difference in weights were then used to determine water to apply to re-establish container capacity. This procedure was done monthly during the study to maintain the containers above 70% of container water holding capacity. There were three irrigation treatments. Treatment one applied 72 ounces at 10:00am, treatment two applied 72 ounces divided into 3 applications of 24 ounces at 10:30am, 1:00pm and 3:30pm, and treatment three applied 72 ounces divided into 6 applications of 12 ounces at 8:00am, 9:30am, 11:00am, 12:30pm, 2:00pm, and 3:30pm. Irrigation was applied through maxi-jet spray stakes supplied by Acuff Irrigation Company of Cottondale Fla. Leachate volumes were recorded from the model pots for each irrigation event.

Results and Discussion: Results indicate that cyclic irrigation and media affect irrigation application efficiency. In model pots irrigation applied once per event had an overall efficiency of 72.3% for trees planted in 100% pinebark compared to 84.1% for trees planted in 80/20 pinebark/coir. Irrigation applied in one cycle had an efficiency of 78.2% compared to 98.1 and 99.2% for the three and six cycle respectively.

There was a significant difference in height and diameter increase between media ($p = 0.05$). Mean height increase ranged from 18.5 inches for the 100% pinebark to 22.8 inches for the 80/20 pinebark/coir. Mean diameter increase ranged from 0.47 inches for 100% pinebark to 0.70 inches for 80/20 pinebark/coir. There was a significant difference in height and diameter increase between irrigation treatments (Table 1) .

Mean height increase ranged from 18.8 inches for the 1(X) treatment to 22.8 inches for the 6(X) treatment. Mean diameter increase ranged from 0.51 inches for the 1(X) treatment to 0.64 inches for the 6(X) treatment. There were no differences in the growth of trees as a result of fertilizer rates.

Significance to the Industry: In summary, preliminary results indicate that both cyclic irrigation and media have an effect on irrigation application efficiency by reducing leachate volume. Cyclic irrigation produced growth of *Quercus acutissima* compared to a single irrigation event. Most nurseries can apply cyclic irrigation methods without changing existing equipment.

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Table 1. Effects of irrigation and media on height[1] end diameter[2] increase.

Media[1]	**height**[4]	**diameter**[4]
100% pinebark	18.5a	0.48a
80/20 pinebark/coir	22.8 b	0.70 b
Irrigation Treatment[2]		
IX	18.8a	0.51a
3X	20.5ab	0.58ab
6X	22.8 b	0.65 b

1 Height in inches.
2 Diameter in inches at 6 inches above soil surface.
3 Irrigation treatments were 2160ml applied in one application per day (1X), 3 applications per day of 720ml (3X), and 6 applications per day of 360ml (6X).
4 Means in the same column followed by the same letter(s) are not significantly different at the P=0.05 level.