Effects of Cyclic Micro-Irrigation and Substrate in Pot-in-Pot Production

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Nature of Work: This study was conducted to evaluate production techniques that would increase irrigation application efficiency [(water volume applied-water volume lost)/water volume applied] to large container trees. Three irrigation treatments (continuous, three cycle and six cycle) and three substrate treatments (100 percent pinebark, 4:1 (v:v) pinebark:coir and 4:1 (v:v) pinebark:peat) were evaluated to determine their effects on irrigation application efficiency, and growth of *Acer rubrum* 'Franksred' (Red Sunset™) in a pot-in-pot production system in Auburn, AL.

Bare root liners, 5-6 ft, of *Acer rubrum* 'Franksred' (J. Frank Schmidt & Son's Co., Boring, Oregon) were planted in #15 containers (Nursery Supplies Fairless Hills, PA) in April 1997 in full sun. Three substrate combinations were used: 100 percent pinebark; 4:1 (v:v) pinebark:peat; and 4:1 (v:v) pinebark:coconut coir. Substrates were amended with 7.7 lbs dolomitic limestone. Trees were topdressed with 0.74 lbs of Scotts 15N-9P-11K plus minors.

Three irrigation treatments were used: application of a given volume in one continuous application at 10:00 a.m., the same volume divided into three applications at 10:30 a.m., 1:00 p.m. and 3:30 p.m., and the same volume divided into six applications beginning at 8:00 a.m. with a 90 minute rest between cycles. Irrigation was applied through maxi-jet spray stakes with a Bosmith pressure compensating emitter (Acuff Irrigation Company, Cottondale, FL) at a rate of 13.5 oz per minute. Total leachate volume was collected on a biweekly basis throughout the study. Leachate samples were taken from all containers monthly using the Virginia Tech Extraction Method (VTEM) and frozen for N analysis at the end of the study. Leachate volumes were collected one day prior to VTEM collection. Total inorganic-N concentrations determined from the VTEM were used to calculate total inorganic-N lost per container (volume x concentration).

Results and Discussion: Irrigation application efficiency was greatest for 4:1 pinebark:peat among substrate treatments while 100 percent pinebark and 4:1 pinebark:coir were similar (Table 1). Irrigation application efficiency was greatest for the six-cycle treatment followed by the three-cycle and continuous, respectively, (Table 1). These results are consistent with prior research showing increased irrigation application efficiency with cyclic irrigation (2, 3, 4). While not compared statistically, irrigation application efficiency appeared to increase as the season progressed, possibly due to increasing plant demands and environmental conditions. This suggest that maximum benefits from cyclic irrigation occur early in the season.

Tree growth was affected by substrates and irrigation treatment (Table 1). Shoot dry weight was about eight percent greater with plants grown in 4:1 pinebark:peat compared to plants grown in 100 percent pinebark. Plants grown in 4:1 pinebark:peat had a 17 percent and 12 percent greater height increase than those grown in pinebark:coir and 100 percent pinebark, respectively. Plants grown with cyclic irrigation had the greatest shoot dry weight among irrigation treatments with plants in the three-cycle and six-cycle having 23 percent and 17 percent greater shoot dry weight, respectively than plants grown with continuous irrigation. Plants receiving three-cycle and six-cycle irrigation treatments had a 23 percent and 26 percent greater trunk diameter increase respectively than plants grown with continuous irrigation. Tree height was also affected by irrigation treatment. Plants grown with three-cycle irrigation had a 16 percent greater height increase than plants grown with continuous irrigation. These results support a previous study showing an increase in growth with cyclic compared to continuous irrigation (3).

Inorganic-N concentration in VTEM samples was greatest for 100 percent pinebark in June. In two of the three sample dates total N lost (mg/pot) was greater in the 100 percent pinebark substrate compared to the other substrates. Summing total N lost from the three sample dates suggest that using a substrate with greater water holding capacity can reduce effluent N by almost 40 percent. Similarly cyclic irrigation reduced total N by a minimum of 82 percent when compared to continuous irrigation. While substrate inorganic N concentration was generally higher in cyclic treatments, reduced leachate volume (i.e. greater irrigation application efficiency) results in less total N leached. These data suggest greater retention of N in the substrate with cyclic vs. continuous irrigation. These results support a previous study showing a decrease in N leached from cyclic treatments compared to continuous (1).

Significance to the Industry: With increasing emphasis on the quantity of water used, growers should consider management practices that improve irrigation application efficiency of pot-in-pot container-grown trees. Cyclic irrigation is a proactive method to improve water quality by reducing runoff and nutrient loss from containers. Also, cyclic irrigation may lead to increased growth in production of specimen trees. Most nurseries can apply cyclic irrigation methods without changing existing equipment.

Literature Cited:

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Table 5. Effects of cyclic irrigation and substrate on irrigation application efficiency and growth of *Acer rubrum* 'Franksred' in a pot-in-pot production system.

Treatment	Irrigation application efficiency[1] (%)	Shoot dry wt (g)	Diameter[2] (cm)	Height (cm)
Substrate				
Pinebark	81.8 b[3]	1203.8 b	1.72 a	109.4 b
Pinebark:peat (4:1)	88.9 a	1303.8 a	1.81 a	122.9 a
Pinebark:coir (4:1)	83.0 b	1223.8 ab	1.74 a	105.3 b
Irrigation				
Continuous	70.6 c	1098.3 b	1.51 b	103.8 b
Three-Cycle	87.6 b	1349.2 a	1.86 a	120.6 a
Six-Cycle	94.3 a	1283.8 a	1.90 a	113.3 ab

[1]Irrigation application efficiency = [(water volume applied-water volume lost)/water volume applied].

[2]Diameter 15 cm above substrate surface.

[3]Mean separation within columns by Duncan's Multiple Range Test, $P = 0.05$.