Water Management

Ken Tilt
Section Editor and Moderator

Effects of Cyclic Micro-Irrigation and Copper Container Treatments on the Growth of Atlantic White Cedar.

Robert C. Trawick, Ken M. Tilt, Harry G. Ponder, and Gary J. Keever
Auburn University, Auburn, AL 36849

Index words: *Chamaecyparis thyoides*, Container Production, Copper Hydroxide, Copper Chloride

Nature of Work: With the prospect of increasing regulation of water usage in container nurseries, irrigation system efficiency has become of prime importance to the nursery industry (2). Cyclic irrigation is a possible answer to this problem. Another common problem in container nurseries is root-bound plants resulting from plants growing too long in a container or putting a vigorously rooting plant in a container that is improperly sized for the rapid growth of the roots. Container copper treatments offer relief from this problem (3). In typical overhead irrigation, water losses of 40-90% due to evaporation and run-off are not uncommon (1). Cyclic, or intermittent, irrigation is a relatively new practice where a plant's daily allotment of water is broken up into a series of irrigation events. Recent research indicates that cyclic irrigation can increase irrigation efficiency by as much as 38% compared to irrigation applied once per day without adversely affecting plant growth and often increasing plant growth (4).

Root-bound plants are slower to establish following transplanting into a larger container or the landscape. Copper applied to the inner surface of containers is effective in reducing surface root development by chemically pruning roots of the plant as they encounter the plant wall. Currently there are two copper treated containers available in the nursery industry, Spin-Out ™ (Spin-Out, Lerio Inc. Mobile, AL) containers coated with copper hydroxide and Root Right™ (Nursery Supplies Inc., Chambersburg, PA) container impregnated with copper chloride.

The objective of this project were to test the effects of cyclic micro-irrigation on growth of Atlantic white cedar, *Chamaecyparis thyoides*, and to evaluate the effects of the two commercial container copper treatments on root growth. A third objective was to evaluate irrigation effects on copper effectiveness.

Seventy-two Atlantic white cedar were planted in 11.4 L containers in April, 1998. Of the seventy-two, twenty-four plants were planted into Root Right™ containers, 24 were planted in Spin-Out™ containers, and 24 were planted into untreated containers. An 80:20 mixture of pinebark:peat moss was amended with 2.98 kg (5 lb/yd^3) of dolomitic limestone and 4.18 kg (7 lb/yd^3) of Osmocote 15-9-11 with minors per cubic meter.

After potting, ten randomly selected containers were saturated with water, allowed to drain for twenty minutes, and weighed to determine maximum water holding capacity or "container capacity." Containers were weighed one day later to determine the amount of water utilized by the plant or lost to evaporation (weight after one day's water loss). The difference in the weights gave the approximate volume of water to apply on a daily basis. This volume was applied to the plants daily in one application, or the volume was divided into 3 or 6 equal applications for the other two treatments. The volume of water applied was adjusted monthly throughout the growing season. Irrigation was applied through Maxijet spray stakes (Maxijet Inc., Dundee, FL) Height, canopy widths, caliper measurements, and root ratings were recorded monthly from April through November.

Results and Discussion: Plants grown under cyclic irrigation had a larger growth index, (height + width 1 + width 2)/3, and caliper than those plants watered once per day. There were no differences in growth between the two cyclic treatments (3 and 6 times/day). Container treatments had several effects on plant growth. Plants treated with copper had a lower root rating (less root-bound) than those plants grown in the copper-free containers. Plants grown in Spin-Out™ containers had a lower root rating than those plants grown in Root Right™ containers. Plants grown in the copper treated containers had a larger caliper than plants grown in copper-free containers. There was no interaction between copper and cyclic irrigation treatments. So, irrigation had no impact on the effectiveness of copper treatments.

Significance to Industry: Water conservation is becoming more important to ornamental producers due to water shortages and environmental regulations. Cyclic irrigation produced growth equivalent to or better than a single irrigation application. Root-bound plants are slower to establish in the landscape. These results show that Root Right™ and Spin-Out® treated containers control excessive root growth. Therefore nursery producers can expect less problems in establishment with the use of copper treated containers.

Literature Cited:

1. Bir, RE 1988. Water and container nurseries. Mountain Nursery Newsletter, March 1988, p1.

2. Fare, DC, CH Gilliam, GJ Keever, and RB Reed. 1996. Cyclic irrigation and media affect container leachate and ageratum growth. J. Environ. Hort. 14(1):17-21.

3. Struve, DK, MA Arnold, and D Chimery. 1987. Red oak whip production in containers. Proc. Intern. Plant Prop. Soc. 34:415-420.

4. Tyler, HH, SL Warren, and TE Bilderback. 1996. Cyclic irrigation increases application efficiency and decreases ammonium losses. J. Environ. Hort. 14:194-198.

Table 1. Effect of irrigation on growth index and caliper of *Chamaycyparis thyoides*

Irrigation	Growth Index[1]	Caliper[1]
1X	90.46	1.85
3X	98.58	2.02
6X	99.04	2.07

[1] Quadratic response (P=0.01)

Table 2. Effect of copper container treatments on caliper and root rating on *Chamaecyparis thyoides*

Container	Root Rating[1]	Caliper
Spin-Out®	1.08 A	2.01 A
Control	4.38 C	1.87 B
Root Right™	3.46 B	2.06 A

Means with the same letter are not significantly different according to DMRT (P=0.05).
[1] 0= 0% Root Coverage, 3= 60% Root Coverage, 5= 100% Root Coverage

Alabama Nurseries Implement Best Management Practices

Glenn B. Fain, Charles H. Gilliam, Ken M. Tilt, Beth Wallace
Auburn University, Dept. of Horticulture, Auburn, AL 36849

Index Words: Water Quality, BMPs

Nature of Work: There is continual growing concern in our society today on the environmental impact of various industries. The nursery industry is classified as a non-point pollution source. Unlike the point source pollution of many industries, which is collected and treated, non-point source pollution is controlled primarily through the adoption of practical and cost-effective best management practices (BMPs). In the early 1990's a cooperative effort among universities and the nursery industry along with the EPA and the Alabama Department of Environmental Management have addressed these concerns. Since then a site specific, menu driven BMPs manual was developed as a cooperative effort among several southern universities, reviewed extensively by the nursery industry, presented at numerous education programs and culminated in 1997 with the publishing of the Best Management Practices Guide for Producing Container-Grown Plants (1).

The purpose of this survey was to evaluate progress made by south Alabama container nurseries in implementing BMPs as well as to establish baseline data for future comparative surveys. Twenty-four container nurseries in south Alabama were surveyed during 1998. Nurseries were divided into the following categories with the percent of total acreage of each category in parentheses: small nurseries 1-10 acres (6.9%), medium nurseries 11-40 acres (19.1%) and large nurseries 40+ acres (74.0%). There were eight nurseries in each category and there was a total of 838 acres surveyed. This survey was conducted using personal interviews and a questionnaire pertaining to water quality practices at the container nurseries.

Results and Discussion: Seventy-five percent of all nurseries surveyed representing 93% of the total acreage surveyed have the capability to capture runoff water (Table 1). Installation of a collection pond as a BMP was more likely to occur with larger nurseries. Even though larger nurseries have thousands of gallons of runoff they captured 75% of the total runoff. When asked whether they recycle their runoff water 25% of the nurseries surveyed stated that they recycle up to 72% of their captured runoff water. Only 50% of the small nurseries had collection ponds probably due to space limitations; however small nurseries with collec-

tion ponds collected most of their runoff water (98%). Fifty-four percent of nurseries surveyed stated that they have a specific person devoted to water management however only 47% of those nurseries directly monitor the efficiency of their irrigation systems. Thirty-eight percent of small nurseries stated they use cyclic irrigation to reduce runoff water while none of the large nurseries were using cyclic irrigation. Failure to implement cyclic irrigation practices with the larger nurseries is probably due to the increased difficulty in managing the irrigation systems around the large labor force associated with these nurseries.
When nurseries were asked about other practices to improve runoff water quality 67% of nurseries representing 71% of acreage surveyed stated that they have installed and/or maintain grass filter/erosion strips to treat runoff water. When asked the question, "what BMPs in pesticide treatment/application have been addressed in the last three years?", many nurseries had increased practices such as: scouting for pests, using horticultural oils, applying herbicide to jammed containers and applying herbicide on a staggered basis (data not shown).

Significance to Industry: Based on the positive response of this survey, it is apparent that south Alabama nurseries are aware of the need for BMPs and are making strides toward the implementation of these practices. Most of these BMPs have been implemented during the past 10 years and are likely the result of nursery industry involvement in developing these BMPs and subsequent educational activities by universities. However it is of some concern that less than 50% of the nurseries surveyed representing only 31% of acres surveyed, monitored irrigation efficiency. In a study conducted in 1989 and 1990 nurseries were asked, "how much irrigation is applied?", growers responded that they normally watered for about 1 hour, applying about 1 inch (2.5cm h^{-1}). However when these nurseries were monitored for two years it was determined that the average amount applied was 0.6 inch (1.6 cm h^{-1}), or 40% less than most nurseries assumed they were applying (1). Due to the abundant supply of water in Alabama many nurseries have not been concerned about water-use efficiency. However proper water use is one of the most important BMPs with improper use being a major contributor of increased surface runoff from container nurseries.

Literature Cited:

1. Fare, D.C., C.H. Gilliam and G.J. Keever. 1992. Monitoring Irrigation at Container Nurseries. HortTechnology 2:75-78.

2. Yeager, T.R., C.H. Gilliam, T.E. Bilderback, D.C. Fare, A.X. Niemiera and K.M. Tilt. 1997. Best Management Practices Guide for Producing Container-Grown Plants. SNA.

Table 1. Water use management practices in south Alabama container nurseries in 1998.

Water use management	Percent by nursery size (acres) 1-10	11-40	40+	% total nurseries	% total acres
Water early in the A.M. when possible	38	38	57	43	42
Cyclic irrigation	38	25	0	21	8
Monitor irrigation efficiency	50	57	33	47	31
Increase media water holding capacity	75	43	57	58	39
Collection Pond	50	75	100	75	93
Installation of grass filter/erosion strips	63	75	63	67	71
Runoff water captured (% captured)	50(98)	75(83)	100(75)	75(85)	93
Recycle runoff water (% recycled)	13(100)	25(48)	38(68)	25(72)	45
Ever tested runoff water	25	38	100	54	84
Test runoff water regularly	13	38	63	38	49
Specific person(s) devoted to water management	100	100	100	100	100

IPM Reduces Pesticides inRunoff Water at a Container Nursery

Jeanne Briggs, Ted Whitwell, R. T. Fernandez,
Melissa B. Riley, Steve Jeffers and Joe Culin
Clemson University, Depts. of Horticulture, Plant Pathology and Physiology, and Entomology, Clemson, SC 29634

Index Words: Container Plant Production, Integrated Crop Management, Integrated Pest Management, Cleary's 3336, Daconil, Gallery, Orthene, Snapshot TG, Subdue

Nature of Work: Integrated pest management (IPM) has become a widely accepted practice for production of monotypic agricultural commodities such as fruits, vegetables and grains (Andrews, 1996). Regular scouting for insects and diseases indicates when to apply pesticides resulting in less pesticide usage than that associated with a scheduled pest prevention program. It follows that IPM could be effectively used in container plant production though the challenges of growing and managing hundreds of different plant species must be addressed (Davidson et al., 1988; Raupp et al., 1992). Scouting must be intensive and organized in order to detect the many (often species specific) pests of the numerous herbaceous and woody container plants. Ideally, pests would be detected on individual species and controlled with pesticides labeled for the species before plant saleability became threatened. The benefits of mixed cropping in supporting beneficial organisms would be protected.

A two year study investigating how IPM affects pesticide amounts in runoff water and crop health was implemented at a large wholesale nursery near Chesnee, SC, in the early summer of 1998. An isolated portion of the nursery contained eight beds (18,000 ft^2 each) that housed 25 species of woody and herbaceous ornamentals in 3 gallon containers. The area was randomized into four IPM treatment beds in which pesticides were only applied to affected plants when damage was noticed and four Traditional beds in which pesticide applications were made on a scheduled and preventative basis. All beds were irrigated under a cyclic regime (30 minute cycles with 1.5 hour rest periods between cycles) and fertilized and pruned according to standard practices. The IPM beds were subjected to weekly in-depth scouting of indicator species *(Azalea kurume, Azalea* 'Blauuw's Pink', *Lagerstromia indica, flex cornuta* 'Burfordi' and *Juniperus virginiana* 'Grey Owl') selected for known pest problems. All other plant species in both treatments were visually checked for pests on a weekly basis. Weed control was accomplished by applying granular preemeergent herbicides on a bi-monthky basis to traditional beds (three applications) with one less application and use of sprayable formulations on IPM beds. Runoff water was collected from weirs installed at the base of the beds after all pesticide applications and analyzed to determine concentrations of chemicals. Weed populations and dry weights were determined at 3 and 5 months after treatments began. Plant quality and health were rated at the end of the growing season to allow comparison between treatments. Specific objectives of the research were:

1. to obtain information on pests, diseases and weed populations at a working container plant nursery throughout the growing season;
2. to compare pesticide usage in traditionally managed beds (scheduled spraying) and Integrated Pest Management beds (spraying in response to a detected, potentially damaging pest);
3. to determine pesticide amounts in runoff water from the traditional and IPM beds.

Results and Discussion: Weekly scouting revealed numerous unanticipated pest problems, as indicator species were not always a good reflection of pest populations. Major pests infestations noted during the growing season are listed in Table 1. The greatest pest problems were lacebug infestations on *Azalea* spp. which continued (on a 4-6 week cycle) throughout the summer and into fall, *Phytophthora* on several coniferous species which may have manifested due to the very wet spring season and which was kept from spreading throughout a crop but not eradicated, sequential flea beetle generations which began on *Itea virgin/ca* but spread to adjacent *Ilex verticillata* cultivars, and wax scale on *Ilex cornuta* 'Burfordi' which only became evident in late fall. Of the 25 species of plants in the study, less than one half hosted almost 100% of the pest problems. Nursery management that encompasses grouping of pest-susceptible and pest-free species would appear to be an effective practice to minimize pesticide use in a container nursery.

Five pesticide applications were made to control and prevent weeds and pests. Preemergent herbicides utilized were Snapshot TG, OH2 and Gallery. Orthene, Sevin and dormant oils were sprayed for insect control, and Cleary's 3336, Daconil 2787, and Subdue were used as fungicides. Table 2 lists amounts of pesticides (a.i.) applied to treatments and amounts recovered in runoff water. Results indicate that the experimental setup is working well and that IPM is a feasible option for reducing pesticide use and for reducing pesticides in runoff water. Amounts of isoxaben (active ingredient in Gallery and Snapshot TG) detected in runoff as a total were 7.6 % of applied for the traditional treatment and 1.26 % of applied amount for the IPM treatment. Amounts of Cleary's 3336, Daconil and Subdue were similarly lower for the IPM treatment. Pesticide amounts in runoff water are reduced when pesticide applications are designed to address specific pests as opposed to preventing pests.

Weed populations were much larger in IPM beds which were subjected to only one preemergent herbicide application during the growing season than in traditional beds which received two herbicide applications. However, preliminary estimates of costs associated with hand weeding compared to costs of herbicide applications indicate that hand weeding does not incure more expense. Plant health was judged at season's end by counting unsaleable plants and by growth indices measurements of five species representing different growth habits. There was no difference in the number of culls among treatments (Figure 1), and growth indexes of plants in treatments were similarly not different. Plant quality was visually acceptable for all species in both treatments.

The study is currently being repeated with an expected completion date of spring 2000.

Significance to Industry: The benefits of integrated pest management techniques to the production of container plants are many. Pesticide usage is reduced and subsequently pesticide amounts that leave application site in runoff water are lowered. Results of the first year of this two year study indicate that plant quality and marketability are not compromised by a reduction in applications of herbicides, insecticides and fungicides.

Literature Cited:

1. Andrews, G. L. 1996, Aphid management threshholds, sampling and control suggestions. Proceedings 1996 Beltwide Cotton Conference 1:106-108.

2. Davidson, J. A., C. F. Cornell and D. C. Alban. 1988. The untapped alternative. American Nurseryman 167:99-109

3. Raupp, M. J., C. S. Koehler and J. A. Davidson. 1992. Advances in implementing integrated pest management for woody landscape plants. Annual Review of Entomology 37:561-585.

Table 1. Pests detected at populations requiring chemical treatment on container plants during the 1998 growing season.

Date	Pest	Species
5/21/98	Lace bugs	*Azalea* 'Blauuw's Pink'
6/1/98	Wax Scale	*Ilex cornuta* 'Burfordi'
6/8/98	Flea beetles	*Itea virginica* 'Henry's Garnet'
6/8/98	nutrient deficiency	*Illicium floridanum*
6/15/98	*Cercospora*	*Hydrangae* 'Nikko Blue'
6/15/98	Flea beetles	*Ilex verticillata* 'Red Sprite'
6/15/98	Caterpillars	*Illicium floridanum*
6/15/98	Barberry loopers	*Berberis x gladwynensis* 'William Penn'
7/13/98	*Cercospora*	*Hydrangae* 'Nikko Blue'
7/13/98	Leaf spots	*Lagerstromia indica* 'Tuscarora'
7/13/98	*Phytophthora* sp.	*Chaemacyparis obtusa* 'Gold Mop'
8/3/98	Japanese Beetles	*Raphiolepsis* x *minor*
7/25/98	*Phytophthora sp.*	*Azalea kurume* 'Coral Bells'
8/17/98	*Phytophthora sp.*	*Thuja occidentalis* 'Smaragd'
8/17/98	*Pythium sp.*	*Thuja occidentalis* 'Smaragd'
8/30/98	*Phytophthora sp.*	*Arborvitae* 'Hetzi Midget'
9/23/98	Flea Beetles	*Itea virginica*
9/23/98	Lace bugs	*Azalea* 'Blaauw's Pink'
10/20/98	Wax Scale	*Ilex cornuta* 'Burfordi'

Table 2. Dates of pesticide applications, amounts (grams active ingredient) of pesticide applied per bed and detected in runoff water for IPM and traditional treatments. Values represent means for n=4 replications.

Date	Pesticide	Pesticides applied (grams a.i.)		Amounts recovered (grams a.i.)	
		Traditional	IPM	Traditional	IPM
July 8	Cleary's 3336	113.5	0	9.53	0
	Daconil	262	0	4.265	0
	Snapshot 2.5 TG:				
	Isoxaben	136.2	0	7.625	0
	Trifluralin	544.8	0	1.043	0
August 4	Cleary's 3336	113.5	4.54	5.67	2.15
	Daconil	262	10.36	3.16	0.71
Sept 2	Subdue Gran	681	79.42	204.3	21.23
Sept 24	OH2				
	oxyfloxurfen	454	454	0.731	0.777
	pendimethalin	227	227	0.380	0.458
Nov 22	Snapshot 2.5 TG:				
	Isoxaben	46.1		0.949	
	Trifluralin	184.3		0.297	
	Gallery 75DF		46.3		0.586
	Treflan		190.4		0.363

Figure 1. Percent number of unsaleable plants (*Arborvitae* 'Hetzi Midget', *Chaemacyparis obtusa* 'Gold Mop', *Hydrangae* 'Nikko Blue', *Azalea* 'Blaauw's Pink') at the end of the growing season for IPM and traditional treatments. Means (n=4) were not significant at *P*=0.05.