SECTION 12
WATER MANAGEMENT

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Maryland Nursery Nutrient Management Survey Report 1995

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Nature of Work: The commercial nursery industry in Maryland is under scrutiny regarding the impact of conventional crop production practices on environmental quality. The commercial greenhouse and nursery industry is the second largest agricultural industry in Maryland in terms of cash receipts after poultry. In 1993 there were 9,000 acres of inspected nursery crops in the state. There is an ongoing effort in Maryland to voluntarily reduce nitrogen and phosphorus nutrient loading into the Chesapeake Bay and its tributaries by 40% by the year 2000. It is not known to what degree Maryland's commercial nursery industry may contribute to this nutrient problem. If nutrient loading is not reduced by voluntary means, regulatory efforts may be made by the State. The purpose of the survey was to gather data to establish a baseline of nutrient and water management practices currently being used by Maryland nursery operations. Studies have been done in other states to determine nitrate nitrogen loading in runoff from nursery operations(1). Information gathered included fertilizer usage and rates, use of filter strips, wastewater recirculation practices to reduce off discharge of nutrients, and fertilizer and irrigation scheduling. 128 Maryland production nurseries 5 acres or larger as identified by the Nursery Inspection Program of the Maryland Department of Agriculture (2) were surveyed by mail, telephone and personal interview using a 17 question questionnaire. The results were categorized where possible into those related to field crops and those related to container crop production.

Results and Discussion: 67 nurseries responded to the survey (52% response rate). Acreage ranged from less than 5 acres to over 2,000 acres. Field Crop Production: One-fourth of the growers responding used little or no irrigation. Of the remaining three-quarters who did irrigate, 22 (54%) used well water, 4 (10%) used ponds and 5 (12%) used streams or rivers for water sources. 4 growers reported that they recycled a portion of their irrigation water back on the crops. Irrigation methods ranged from hand held to traveling gun and overhead sprinkler systems. Two nurseries reported having 70 to 75 acres in field production under trickle systems controlled at a central computer. Only one grower used tensionmeters to establish soil moisture levels and to provide guidance on irrigation scheduling.

The majority of the field nursery crop producers applied fertilizer once a year. Seventy percent of nurseries growing field-growing deciduous shrubs and tree stock were following the University of Maryland recommended rates of nitrogen per year. Survey results indicated nitrogen application rates for deciduous shrubs and trees ranged from 0 to 7.1 lbs per 1,000 sq. ft. For field production of evergreen shrubs and trees the rates ranged from 0 to 7 lbs. Per 1,000 sq. ft Seventy two percent of field-grown evergreen shrub and tree stock and 87 percent of nurseries growing in-ground beds of perennials and woody plants were following the recommended rates.

Container Production: Thirty three of the 67 nurseries surveyed produced container nursery stock. Sixty percent of the growers used overhead sprinkler irrigation, 30 percent used hand watering and only 10 percent used trickle. Eighty seven percent of the container operations used manual controls for irrigation, 10 percent used time clocks, and 9 percent used a centrally controlled computer. Fourteen nurserymen (42%) reported that they captured water for reuse; 27 (81%) used grass waterways or buffer strips to direct the water flow.

Of the 33 nurseries surveyed, 50 percent used a controlled release fertilizer and only 2 percent supplemented with a liquid fertilizer. About half of the operations added the slow-release fertilizer to the top of the potting substrate, 42 percent mixed in the fertilizer with the substrate at planting time. Of the 33 container nurseries, 28 responded with the complete fertilizer rates that they used (based on nitrogen). Thirty three percent used less than 1 lb. of nitrogen per 1,000 ft. sq., 16 percent used 1 - 1.3 lbs., 24 percent used 3.1 to 5.1 lbs., 9 percent used 5.1 to 7 lbs. And 18 percent used more than 7.1 lbs. Over half of the nurseries (63%) followed a fertilizer schedule recommended for each crop. Thirty three percent used a substrate test to determine when and how much fertilizer to apply and 12 percent used soluble salts readings to apply and monitor fertilizer use. Five nurseries used a combination of a fertilizer schedule with a substrates test or a soluble salts test to determine application rates and times.

Significance to the Industry: This survey establishes a baseline of information on irrigation and fertility production practices used by Maryland nursery operations. Results indicate that most Maryland nurseries are managing their nutrient applications and irrigation in an appropriate manner with current technology. Proper nutrient application rates, use of buffer strips, and collection of runoff water, where practical, are generally used by growers. Results of this survey will be shared with the Maryland Nurserymen's Association and appropriate state and environmental authorities. Where excessive nutrient loading into the groundwater or surrounding streams may exist, they will be remedied on a specific site by site basis by the grower working the Maryland Cooperative Extension Service.

Literature Cited

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Container Irrigation Based on Substrate Moisture Tension Reduces N Leaching

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Nature of Work: Many container nurseries in the southern U.S. irrigate daily for a prescribed time to deliver a set amount of water that is often in excess of substrate water holding capacity (1,3). The concentration of N03-N in the resulting runoff water commonly exceeds 10 ppm (7), the federal drinking water standard often cited as an upper limit for agricultural runoff. Scheduling irrigation to replace but not exceed evapotranspiration (ET) from the container substrate since the previous irrigation would conserve water and, hopefully, minimize water quality degradation due to nutrient runoff from production areas. However, since nursery container substrates are subject to leaching rainfall, it is not clear to what extent improvements in irrigation efficiency will reduce the total N03-N content of container effluent.

Gonzalez et al. (4) used a wetness sensing grid placed beneath indicator plants within a container block to signal a controller to stop irrigation when container capacity was exceeded. This system reduced the amount of water applied to and leached from container-grown red oak by 95% in comparison to conventional irrigation practice but the influence of this type of irrigation scheduling on container effluent N03-N content was not determined. Using a similar system based on substrate moisture tension (SMT), we compared daily irrigation to replace ET to daily irrigation with a set amount for effects on plant growth, nutrient efficacy, effluent volume, and effluent N03-N content and concentration.

Liners of *Juniperus scopulorum* 'Moonglow' were planted in May in 3-gallon containers in a substrate of 8 bark:2 peat; 1 sand amended with 5 Ibs dolomitic limestone/yd^3. Plants received weekly fertigation at 300 ppm N as 21-7-14 until fertilizer treatments were applied on July 17. Fertilizer treatments were a topdressed application of Osmocote 18-6-12 at 25, 37.5, 50, or 75 g/container. Irrigation treatments, initiated July 24, were 1) tension-based: replacement of daily ET by irrigation to container capacity on the basis of SMT as measured by an electronic tensiometer (2) or 2) time-based: daily irrigation for a set time to supply 800 ml/container. Irrigation was applied through a computer-controlled drip system (5). For treatments based on SMT, irrigation was applied each morning until a tensiometer placed at the vertical center of the container substrate signaled the irrigation controller that SMT was less than a set value corresponding to container capacity. Irrigation of the treatments was based on the SMT of a single randomly selected indicator plant per treatment.

This study was conducted outdoors on a bench designed for collection of the effluent from individual containers. The experimental design was a RCB with a factorial arrangement of two irrigation regimes and four fertilizer rates. There was one container per treatment in each of eight blocks. The volume of weekly effluent from each container was measured and a subsample taken for NO3-N analysis. Total effluent NO3-N content was calculated for each treatment as the sum of the weekly products of effluent volume and N concentration. Plants were harvested after 13 weeks for shoot and root dry weight determination.

Results and Discussion: Plant dry weights were not influenced by irrigation or fertilizer rate (Table 1). The volume of irrigation applied under time-based irrigation was 2.6 times greater than that required to replace ET under tension-based irrigation (75.0 vs 28.9 liters/container). There was 13.3 inches of rainfall during the experimental period, which amounts to an additional 18.8 liter/container, accounting for most of the effluent collected from tension-based treatments. Although effluent volume was 69% less for tension-based than for time-based irrigation (Table 1), total effluent NO3-N content was only 23% less for tension-based than for time-based irrigation. This result is due to the significantly higher concentrations of NO3-N in the effluent from containers receiving tension-based irrigation (Fig. 1). Niemiera and Leda (6) have shown that irrigation amount has little influence on the N-release rate of controlled-release fertilizers (CRF) such as Osmocote. Our results demonstrate that NO3-N released from CRF in excess of plant uptake which has not been leached due to efficient irrigation may be leached at higher concentration during incidents of rainfall.

Significance to Industry: Daily irrigation to replace ET resulted in less water applied, less container effluent, less total effluent NO3-N than daily irrigation with a set amount. Although this more efficient irrigation practice would reduce total NO3-N loading into surface and ground waters due to nursery runoff, higher effluent NO3-N concentrations which result from this type of water management may be of concern to state or federal regulators.

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Table 1. Influence of daily irrigation with 800 ml per 3-gallon container (time-based) or to replace ET on tensiometer readings (tension-based) on Juniperus scopulorum dry weights, container effluent volume and effluent NO3-N content after 13 weeks.

Treatment	Dry weights		Effluent	
Irrigation basis	shoot wt., grams	root wt., grams	volume, liters	NO3-N, grams
time	63.2	2.44	56.8	2.70
tension	66.2	2.25	17.8	2.08
N applied, grams				
4.5	62.8	2.36	40.0	1.08
6.8	64.0	2.60	39.0	2.03
9.0	66.0	2.42	33.4	2.50
13.5	66.3	1.98	36.8	3.95
Significance				
irrigation (I)	NS	NS	***	***
nitrogen (N)	NS	L*,Q*	L*	L***
I x N	NS	NS	NS	NS

***,**,* Significant at $P \leq 0.001$, 0.01, or 0.057 respectively.

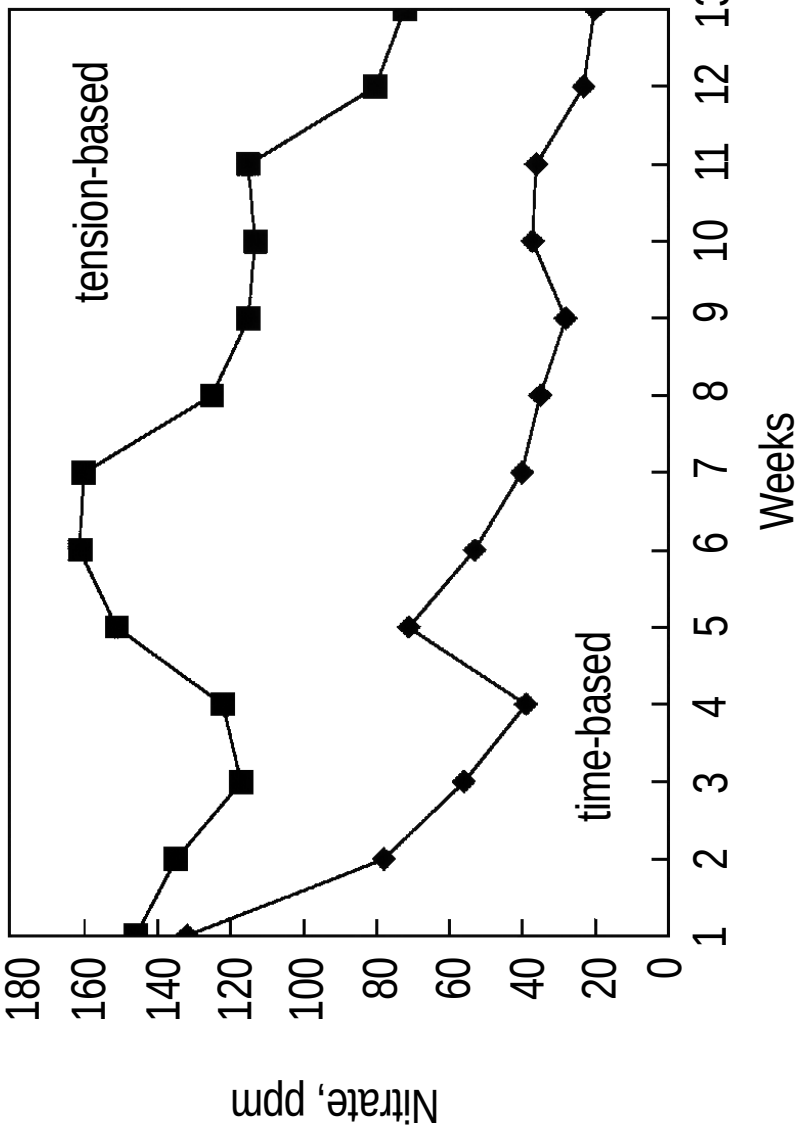

Figure 1. Container effluent NO3-N concentration as influenced by irrigation regime over 13 weeks.