Extension Education Methods

Survey of Container Nursery Irrigation Practices in West-central Florida: An Educational Opportunity

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SUMMARY. A survey was conducted of nursery operators participating in workshops in west-central Florida. The purpose of the survey was to identify the irrigation best management practices (BMPs) adopted by container nurseries in west-central Florida and obtain information regarding emphasis of future extension educational programs. Workshops were conducted in Hillsborough County, Fla., and Manatee County, Fla., and participation was voluntary. Respondents were asked about BMPs used in the nurseries according to the irrigation system used and it was found that the majority of the nurseries relied on well water as the primary source for irrigation. While 69% of the nurseries monitored uniformity of microirrigation systems, only 35% monitored uniformity of overhead irrigation systems. Thirty-four percent of the nurseries collected irrigation or rain runoff and 9% knew the water holding capacity of their substrate. Most of the nurseries grouped plants by irrigation requirements (74%) and grouped container sizes by irrigation requirements (69%). The survey indicates that many BMPs are not widely adopted by nurseries in west-central Florida. The information from this survey can be used as a guide to focus the efforts of university extension educational programs to achieve greater adoption of BMPs.

Container plant production is a very important sector in Florida's economy. Florida is the second largest state in production of ornamental plants and the production

of nursery crops is the fastest growing sector of Florida agriculture (Larson and Nesheim, 2000).

Container production of nursery crops differs from other agricultural production systems in its use of a limited volume of a soilless substrate, which requires frequent irrigation to maintain sufficient water for optimum plant growth. When irrigation is not managed appropriately, leaching of

applied fertilizer elements can occur. Chen et al. (2001) reported up to 50% of nitrogen leaching during containerized plant production. Nutrient-rich leachate can percolate through the soil and eventually reach the water table or it can contribute to runoff and end up in surface water. Whether in ground water or surface water, nutrient leaching can become an environmental problem. Therefore, irrigation management is critical in conserving water and minimizing non-point source pollution of waters.

Water supplies in several regions in Florida have been reduced by prolonged drought and increased demand. Consequently, restrictions have been imposed to conserve water and reduce environmental consequences. Water users including the nursery industry have been called upon to take measures to improve the efficiency and beneficial use of water. The response to this situation was the development and adoption BMPs. The Southern Nursery Association, in association with several research institutes and universities, has developed an extensive BMPs guide (Yeager et al., 1997) for producing container-grown plants that has been adopted in many states in the southeastern U.S. Regionally specific BMP guides are currently being developed. For instance, a BMPs guide for southern Florida will be available soon.

While grower associations and extension services have been encouraging nurseries to adopt BMPs, there is little information on the status of voluntary adoption of these practices. The objectives of this study were to identify the irrigation BMPs adopted by container nurseries in west-central Florida and to identify opportunities for research and extension programs to promote BMPs adoption.

Materials and methods

Surveys were conducted at a series of irrigation management workshops entitled "Improving Irrigation Application Efficiency" that were organized for commercial container nursery operators during 1999–2002. Workshops were 2-d programs and consisted of

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Units

To convert U.S. to SI, multiply by	U.S. unit	SI unit	To convert SI to U.S., multiply by
0.4047	acre(s)	ha	2.4711
2.54	inch(es)	cm	0.3937

presentations about container and substrate effects on irrigation needs, procedures for characterizing physical properties of substrates, water saving techniques, and container plant water needs. Hands-on activities to determine substrate physical properties, factors influencing water capture by containers, overhead irrigation water capture, and overhead and microirrigation application uniformity were integral components of the workshops. Workshop materials were based on the "Best management practices guide for producing container-grown plants" (Yeager et al., 1997).

In 1999–2000, a survey was administered to participants of four 2-d workshops held at the Hillsborough Community College in Plant City, Hillsborough County, Fla. In 2001–02, the same survey was administered to participants of four 2-d workshops held at the Gulf Coast Research Education Center in Bradenton, Manatee County, Fla. Hillsborough and Manatee counties are located in U.S. Department of Agriculture (USDA) climate zone 9. This zone is unique in that nurseries in it predominantly produce subtropical plant material that is sold mostly in central Florida. In contrast, southern Florida, which is USDA climate zone 10, produces tropical plant materials, and northern Florida, which is USDA climate zone 8, produces temperate plant material that is sold to other

states. Hillsborough and Manatee counties encompass the majority (about 695 nurseries, Florida Department of Agriculture and Consumer Services, 2004) of nurseries producing landscape plants in zone 9.

The survey was presented at the beginning of the workshops and participation was voluntary. The survey consisted primarily of multiple choice questions categorized according to irrigation delivery system. In addition, there were a few questions where respondents completed the blank. Although some nurseries had more than one participant attending a workshop, only one participant responded to the survey. Participants signed a University of Florida Institutional Review Board consent form. Workshops were advertised by flyers and conducted by the extension service of University of Florida. The Southwest Florida Water Management District funded the workshops and there was no charge for educational materials.

The survey in Hillsborough County, Fla., was completed by 39 participants and the survey in Manatee County by 19 participants. The majority of survey participants worked in Florida nurseries located in USDA climate zone 9. Data in Tables 1–4 present the combined results of both workshops. A percentage of the number of respondents for each question was calculated.

Results and discussion

In the first workshop series, 37 nurseries used overhead irrigation systems; among those, 16 also used microirrigation and two used exclusively microirrigation. In the second educational workshop series, 17 nurseries used overhead, among those 13 also used microirrigation and only two used exclusively microirrigation.

The median size of nurseries irrigated primarily by overhead systems was 6.75 acres (ranged from 0.01 to 160 acres), while the median size of nurseries irrigated by microirrigation was 8 acres (ranged from 0.25 to 1000 acres) (data not shown).

The primary source of water used for both microirrigation and overhead was well water and only 6% or less of the nurseries used municipal water (Table 1). Twenty-two percent of the nurseries used surface water for overhead irrigation systems and only 9% of the nurseries used surface water to irrigate with microirrigation.

When respondents were asked if they monitor irrigation uniformity, 35% of the nurseries that irrigate with overhead systems responded affirmatively (Table 2). In contrast, considerably more nurseries (69%) indicated that they monitored uniformity of microirrigation. While 48% of the nurseries monitor water quality of overhead systems, 42% monitor water quality

Table 1. Water source used to irrigate container nurseries in west-central Florida.

Water source	Nurseries (%) ^z	
	Overhead	Microirrigation
Well	93 (54)	91 (33)
Surface	22 (54)	9 (33)
Municipal	4 (54)	6 (33)

^zPercentage of nurseries surveyed (n).

Table 3. Factors aiding nursery operators with the determination of irrigation frequency in west-central Florida.

Determination of irrigation frequency	Nurseries (%) ^z
Indicator plant	9
Visual observation	74
Sensor	9
Fixed	59

^zPercentage of nurseries surveyed (n = 58).

Table 2. Container nurseries in west-central Florida using selected best management practices (BMPs) to manage irrigation.

BMPs	Nurseries (%) ^z	
	Overhead	Microirrigation
Monitor irrigation uniformity	35 (54)	69 (32)
Monitor water quality	48 (54)	42 (33)
Chemical injection	22 (54)	25 (32)
Use of cyclic irrigation	42 (53)	47 (32)

^zPercentage of nurseries surveyed (n).

Table 4. Best management practices (BMPs) adopted by container nurseries with overhead and microirrigation systems in west-central Florida.

BMPs	Nurseries (%) ^z
Collect irrigation or rain runoff	34 (58)
Know water holding capacity of substrate	9 (53)
Group plants by irrigation requirements	74 (58)
Group container sizes by irrigation requirements	69 (58)
Use any other grouping for irrigation requirement	26 (42)
Monitor amount of water applied each irrigation	34 (56)
Monitor the application pressure in irrigation	45 (56)
Use automatic rain shutoff	29 (34)

^zPercentage of nurseries surveyed (n).

when using microirrigation. Greater concerns with water quality using overhead irrigation are likely due to leaf staining from calcium carbonate or iron. However, poor water quality can also be a problem with microirrigation. Unsuitable water quality can negatively affect substrate pH and can increase mineral depositions inside the emitters, thereby decreasing water flow and affecting irrigation uniformity. Twenty-two percent and 25% of the nurseries that irrigated with overhead and microirrigation, respectively, injected chemicals for water quality improvement.

Cyclic irrigation has been reported to have many advantages over non-cyclic or single application irrigation. This method of irrigation has been shown to decrease the volume of irrigation runoff by 30% (Fare et al., 1994) and increase tree growth and irrigation efficiency (Beeson Jr. and Haydu, 1995). About 42% of the nurseries used cyclic irrigation with overhead systems and 47% of the nurseries reported using cyclic irrigation with microirrigation systems. The reason fewer nurseries used cyclic irrigation with overhead systems is probably due to the difficulty of coordinating labor tasks with irrigation events. Moreover, without automation using electronic controllers and solenoid valves, cyclic irrigation is difficult to manage (Yeager et al., 1997).

Many nurseries used more than one method to determine when to irrigate (Table 3). Visual observation was the primary method (74%). Only 9% of the nurseries used sensors and 59% used a fixed schedule. Among those using fixed schedule, only 29% of them used an automatic rain shutoff (Table 4).

About 34% of the nurseries reported collecting irrigation or rain runoff (Table 4). The knowledge of the water holding capacity of the substrate is critical to determine the amount of irrigation application; however, only 9% of the nurseries knew the water holding capacity of their substrate, while more than two-thirds of the nurseries grouped plants by container sizes and irrigation requirements. Only one-third of the nurseries surveyed monitored the amount of water applied during each irrigation event. About 45% of the nurseries monitored the irrigation application pressure.

Summary and conclusions

For many container nurseries, it is advisable to use microirrigation for #7 containers (about 14-inch diameter) and larger (Yeager et al., 1997) instead of overhead systems to conserve water and decrease leachate. Overhead irrigation is crucial to the container nursery industry in Florida as a means of protecting plants from cold temperatures (Swisher et al., 1994). However, four nurseries (two nurseries from each series of workshops) used exclusively microirrigation. Regional characteristics should be considered when BMP recommendations are made.

It is interesting to note that only 35% of the nurseries monitor irrigation uniformity of overhead irrigation systems, but 69% of the nurseries monitor irrigation uniformity of microirrigation systems. This might indicate that growers using microirrigation are more aware of the importance of uniformity. Growers should be educated about the importance of maintaining the uniformity of overhead systems as well, as an excessive volume of water is needed to irrigate crops when a system has poor uniformity (Yeager et al., 1997).

The primary method to determine irrigation need reported by participants in both educational programs was visual observation. However, 59% of the nurseries also irrigated crops on a fixed schedule. Among those nurseries that irrigate on fixed schedules, only 29% of them had a rain shutoff to prevent irrigation system operation immediately following rain. Although irrigation timers can be controlled manually, the use of a rain shutoff could help conserve water and also minimize nutrient runoff (Yeager et al., 1997), if other provisions to control irrigation are not feasible. Rainwater could substitute for some irrigation events, considering that Florida receives an average of 53 inches of rain per year and some areas receive 64 inches of rain per year (Geraghty et al., 1973).

An area that needs attention is the knowledge of water holding capacity of the substrate used in the nurseries. Only 9% of the nurseries knew the substrate water holding capacity, although this information is essential to calculate the amount of irrigation to be applied to avoid leaching. There is little information on adoption of BMPs throughout the country, but the situation in other

areas is probably not much different from that in west-central Florida.

A survey of nurseries in Georgia (Garber et al., 2002) showed that 48% of the nurseries collect runoff water; in contrast, only 34% of the nurseries in west-central Florida collected rain or irrigation runoff. The low number of nurseries in west-central Florida collecting irrigation and rain runoff is probably due to feasibility to implement collection basins. For instance, soils of the uplands and low ridges in Florida are moderately to well drained, while soils of the flatwoods are poorly drained (Doolittle et al., 1989), which makes implementation of collection structures a challenge. Therefore, regional differences should be considered when educational programs are developed to fulfill the needs of a site-specific menu-driven BMP program.

It is reasonable to assume that continued population growth, severe and prolonged droughts, and reduced water quality will place further demands on a limited water supply. In several states, water restrictions for lawn and landscape irrigation are already established. For example, several water districts in California have already instituted water budgets based on the water needs of individual properties. In many Florida counties, agricultural irrigation for overhead systems is allowed between the hours after 4:00 PM and before 10:00 AM daily, while traveling volume gun irrigation is allowed between the hours of after 5:00 PM and before 11:00 AM daily (St. Johns River Water Management District, 2006). Municipalities in many states throughout the U.S. have already imposed various water restrictions, and further restrictions to residential and commercial water use are under consideration (Irrigation Association, 2006). Facing this situation, industry must learn how to effectively manage water use in the nursery. Several states are encouraging nurseries to implement BMPs and surveys have shown that nurseries can be proactive in addressing environmental issues related to production of container-grown crops (Fain et al., 2000; Garber et al., 2002).

The survey indicates that BMPs are not widely adopted by nurseries in west-central Florida. Most of the BMPs assessed in the survey were used by less than 50% of the respondents.

This survey provides important information regarding the BMPs being used by some growers in west-central Florida. This information can be used as a guide to focus the efforts of grower groups, public agencies, university research and extension programs to increase BMP adoption. Some specific BMPs that extension educators and others should focus on include:

- Uniformity of overhead sprinkler systems
- Effective use of rain and conserving water with rain shutoff devices
- Collection and reuse of rain and irrigation water
- Determination of water holding capacity of substrate
- Monitoring amount of water applied in relation to water holding capacity of substrate (leaching percentage or leaching fraction)
- Use of cyclic irrigation to minimize water and nutrient loss from containers
- Use of substrate moisture sensors for initializing irrigation, rather than fixed schedule.

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