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Involvement of Nursery Operators and Educators in Development of Fertilization and Irrigation Regulation

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ADDITIONAL INDEX WORDS. guidelines, proactive, interim measure, BMP, incentive-based regulation

SUMMARY. Nursery operators had the opportunity to participate in a process to develop a voluntary incentive-based regulation that consummated the consensus of nursery and regulatory personnel regarding the best fertilization and irrigation cultural practice information available for producing plants in containers. Florida Department of Agriculture and Consumer Services (FDACS), which has statutory authority to develop and adopt practices by administrative rule, administered the process, and they relied on university extension personnel to provide education so nursery operators would be prepared to implement practices consistent with the regulation. Nursery operators who voluntarily implemented these practices received a waiver of liability from the recovery costs associated with the cleanup of groundwater contaminated with nitrate nitrogen if each of the following activities had taken place: 1) a notice of intent was filed with FDACS to implement accepted practices; 2) practices based on consensus of the industry were used and guidelines followed; and 3) fertilization and irrigation records were maintained. Participation in an industry-driven regulatory program where nursery operators agreed to use the best cultural practices available prior to the identification of a specific groundwater issue was a significant proactive step for the industry.

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Restrictions on public activity are imposed usually to protect physical items, natural resources, or provide for public safety. This protection should be conceived in the best interest of society and must pass the judgment of time. While restrictions may be guidelines or policies not upheld by statutory authority, when they become laws they are termed regulations. The number of regulations having an impact on the nursery industry has increased dramatically in recent years. For example, many nursery personnel remember when compliance with worker protection standards started. No doubt, this was an important regulation to ensure the safety of pesticide applicators and workers. More recently, labor laws and laws regulating the importation of plants and transportation of pest-free plants have received a lot of attention.

The purpose of this manuscript is to call attention to and describe the types of regulations impacting the nursery industry and provide insight with regard to characteristics of regulations. This is important for understanding the processes by which regulations are developed. If educators and nursery operators understand the process, perhaps they will be more involved in the process. Involvement is crucial to ensure regulations are fair and effective. Additionally, I will share my experience with developing a voluntary incentive-based irrigation and fertilization regulation for Florida's nursery industry. I will not argue in favor of or against regulations.

Direct and indirect impact of regulations

Regulation is defined in the American Heritage Dictionary (Morris, 1980) as a "law or rule to control or govern behavior." Regulation of societal behavior dates back to the 14th century (D. Chopin, personal communication) of English law, and today our behavior and activities are still impacted by regulations. The same is true for the nursery operation. Certain regulations indirectly impact the nursery operation. For example, pesticides, fertilizers, plastics, and other products purchased by the nursery are regulated during manufacture. Other regulations, e.g., employee wage and hour laws, worker's compensation and taxes, insurance, chemical disposal and

discharge, pest quarantines, quantity of water used, time of day for irrigation, and land use regulations, impact directly the nursery activities. Regulations impacting directly the nursery operation are usually at the forefront of the operator's daily agenda; these are also the regulations that a nursery operator or extension educator might have had an opportunity to exert the most influence on during development. Involvement in the development process is time consuming and may be antagonistic, but it is crucial that operators and educators be involved so that the best information available is considered. Understanding general characteristics of regulations impacting the nursery industry can be insightful and helpful as one becomes involved and engages in the challenges of the development process.

Characteristics of regulations impacting nurseries

Listed below are some characteristics of regulations impacting nurseries. These characteristics represent non-exhaustive summaries of my observations and experiences from involvement in the development of a regulation for the Florida nursery industry.

DIFFICULT TO ENFORCE. The nature of some regulations impacting the nursery industry, along with what is regulated, can make them difficult to enforce. For example, restrictions on the time of day when overhead sprinkler irrigation water may be applied is difficult to monitor or enforce due to the geographic locations of nurseries and the fact that all plants may not be irrigated on a regular schedule.

COMPLEX IN NATURE. Regulation development and interpretation involves political, social, emotional, and scientific considerations. Consequently, this vast array of considerations and opinions contributes to a very complex composition, such as for a fertilizer or pesticide label.

NOT ALWAYS SCIENCE-BASED. Sometimes the scientific evidence is not strong or the non-scientific consequences enough to convince the public to base a regulation on science. In addition, the public might not wait for scientific discoveries or proof of theory. Consequently, despite the best intentions and available information, regulations may be developed based on emotion, implications, or what seems to be public desire. For

example, application of a fertilizer with specific nutrient composition may be restricted in a locale if research is lacking that proves applying the fertilizer according to prescribed management practices would result in harm to the environment.

POLITICS IS IMPORTANT. Pros and cons of regulations are often debated in the development process. The political infrastructure of this debate may impact the outcome. Thus, it is very important for nursery and trade associations to be involved to ensure representation for its members.

NOT ALWAYS ECONOMICAL. Implementation or compliance with regulations is not always economical. Nursery operators in Florida must retain and reuse overhead sprinkler irrigation water if they inject nitrogen fertilizer and wish to comply with rule 5E-1.023 (Florida Department of State, 2004). Hence, some nursery operators will need to construct runoff collection systems that may qualify for cost share funds from governmental agencies.

NOT ALWAYS LOGICAL. Regulations may not concur with the reasoning of educators or nursery operators, or may not seem to add order to a sequence of events. However, it is important in determining if something is logical to make sure perceptions are tempered with understanding of others. For example, a regulation forbidding overhead sprinkler irrigation in the afternoon may not be logical considering that high humidity and large water drops result in relatively low evaporation. However, it might be better to embrace this regulation and enhance public perception than deal with more onerous regulations. So nursery operators and educators have an important role to assume in regulation development, both understanding the reasoning of others and ensuring the best available information is considered by those involved with regulation development.

Example of regulation development in Florida

The "nitrate" legislation of 1994 (Division of Statutory Revision of the Florida Legislature, 2004) provided FDACS with the statutory authority to work with all agricultural producers to develop interim measures and best management practices (BMPs) that were economically and techni-

cally feasible. Thus, the framework was established for Florida nursery operators to cooperate with FDACS to commit to rule or law their best available information for practices regarding irrigation and nitrogen fertilization. The legislation was different from traditional regulatory programs because it specifically stated that growers could voluntarily adopt accepted practices, and in exchange for adopting and implementing the approved practices and keeping appropriate records (irrigation and fertilization records for nurseries), they receive a waiver of liability from the recovery costs associated with the cleanup of nitrate-contaminated groundwater. To develop a document of accepted practices, the statewide nursery organization, Florida Nurserymen and Growers Association, convened a task force (14 Oct. 1999) to sift through information to potentially include in the document of best practices. I provided guidance and direction by helping the task force during a series of meetings to refine and capture pertinent information and thoughts in a concise written format that comprised a draft document of irrigation and fertilization practices. The document represented the consensus of the task force and is an interim document until BMPs verified by research are developed. The task force relied primarily on research-based information, although more specific water quality research will be necessary to develop a comprehensive BMP for all nurseries. To further ensure these practices were acceptable to the industry, another series of meetings was conducted statewide for interested parties to review and provide input on the content of the document. Once this input was obtained and the draft document, titled *Interim Measure for Florida Producers of Container-grown Plants*, was revised, the document was adopted by administrative rule (Florida Department of State, 2004). Extension education commenced statewide to help nursery operators implement irrigation and fertilization practices noted in the document. The involvement of nursery operators in the development of this voluntary incentive-based regulation was crucial because they are the ones using the practices. Text of the document adopted by rule can be viewed online (Florida Department of Agriculture and Consumer Services, 2003).

Conclusions

The nursery industry in Florida provided input to the process for development of a voluntary incentive-based regulation to address groundwater quality concerns. This process, which relied on industry and regulatory personnel consensus, was different than the traditional process for developing regulations. Even though it was not a novel concept, it was initially awkward or different than past industry regulatory experiences. There were several reasons for the awkwardness that are outside the scope of this discussion, but the nursery industry's participation in the process was important because it resulted in a proactive solution to deal with nitrate contamination of groundwater. Additionally, the experience and confidence gained from the process was important because the nursery industry had to reach a consensus and commit to make changes when a crisis did not exist. It brought to the forefront an urgency of proactiveness and a sense of how one's small involvement can contribute to something that was unachievable alone. This experience will be invaluable as the industry embraces future urban challenges.

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More Plant per Gallon: Getting More Out of Your Water

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ADDITIONAL INDEX WORDS. irrigation efficiency, water application efficiency, irrigation scheduling, irrigation timing, cycled irrigation, container substrate, clay

SUMMARY. Irrigation of container-grown ornamental crops can be very inefficient, using large quantities of water. Much research was conducted in the 1990s to increase water efficiency. This article examined water management, focusing on three areas: water application efficiency (WAE), irrigation scheduling, and substrate amendment. Increases in WAE can be made by focusing on time-averaged application rate and pre-irrigation substrate moisture deficit. Irrigation scheduling is defined as the process of determining how much to apply (irrigation volume) and timing (when to apply). Irrigation volume should be based on the amount of water lost since the last irrigation. Irrigation volume is often expressed in terms of leaching fraction (LF = water leached ÷ water applied). A zero leaching fraction may be possible when using recommended rates of controlled-release fertilizers. With container-grown plant material, irrigation timing refers to what time of day the water is applied, because most container-grown plants require daily irrigation once the root system exploits the substrate volume. Irrigating during the afternoon, in contrast to a predawn application, may increase growth by reducing heat load and minimizing water stress in the later part of the day. Data suggest that both irrigation volume and time of application should be considered when developing a water management plan for container-grown plants. Amending soilless substrates to increase water buffering and reduce irrigation volume has often been discussed. Recent evidence suggests that amending pine bark substrates with clay may reduce irrigation volume required for plant production. Continued research focus on production efficiency needs to be maintained in the 21st century.

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Water management in container-grown plants became a very hot topic in 1988 and has remained so until today (Urbano, 1989). This article will examine water management from the container perspective (i.e., how can we improve water management within the container?). Water management in the container can be broken down into three areas: water application efficiency, irrigation scheduling, and substrate amendment.

Water application efficiency

Water application efficiency (WAE) involves increasing the retention of water applied to the container. WAE is often calculated as:

$$[(\text{water applied} - \text{water leached}) \div \text{water applied}] \times 100$$

There are two factors that have a direct effect on WAE: time-averaged application rate (TAAR) and pre-irrigation substrate moisture deficit (PISMD). WAE tends to increase with decreasing TAAR by allowing time for water to move through the micropore system of container substrate. Currently we decrease the TAAR by using cyclic application, where the daily water allotment is applied in a series of cycles comprised of an irrigation and a resting interval. Cyclic application is time-averaged, which comprises the application rate of the emitter, application duration, and interval between applications (Zur, 1976). Application of water may be delivered at a high rate, but when the interval between applications is taken into account, the TAAR can be quite low. This technique was borrowed from field research conducted in the 1970s (Karmeli and Peri, 1974). El Modeno Gardens (Irvine, Calif.) first reported use of cyclic irrigation in a container-grown nursery (Whitesides, 1989). The facility reduced water use by 30% with cyclic irrigation. This was done before most of the cyclic irrigation research was conducted with containerized plant production in the 1990s. Lamack and Niemiera (1993) and Karam and Niemiera (1994) conducted some of the early cyclic irrigation research with soilless substrate, illustrating its value in increasing WAE.

Cyclic application can improve WAE with both overhead application and microirrigation (Table 1). The reduction in water use (30%) with cyclic irrigation at El Modeno Gardens was