**Water Conservation Field Day - Agenda**

10:00 am  Welcome and Introduction

10:30  Nursery Tour

11:30  Substrate Aeration, Drainage, & Water Holding Capacity Demonstration

12:00  Lunch  
*(only those that have pre-registered are guaranteed a lunch).*

1:00 pm  Water Quality Discussion

2:00  Adjourn
Introduction:
Texas Cooperative Extension, the Texas Nursery & Landscape Association and the Texas Water Development Board have initiated a collaborative project to estimate the annual volume of water used by nursery/floral crop producers statewide. This project also will investigate the use of Best Management Practices (BMPs) dealing with water conservation and quality.

Why is this important?
Water availability and quality are among the most critical issues facing the Texas GREEN Industry. Numerous regulatory plans and guidelines which will impact future water use in the production of nursery and floral crops are now in place. Despite the scale of the GREEN industry, there is little quantitative information regarding how/how much growers use water in their operations. In addition, there is limited information on how many Texas nursery/floral crop producers currently use BMPs as described in the Texas Water Development Board’s Water Conservation Best Management Practices Guide (TWDB Report 362).

The 2002 Texas State Water Plan, calls for irrigation water conservation strategies in 60 counties, for a total of 669,447 acre-feet of savings in the year 2010 and 866,981 acre-feet of savings in 2050. Eleven counties in the state have 6 or more Class 4 nurseries; of these 11 counties, eight have irrigation water conservation strategies in the 2002 Plan to meet unmet needs. Conservation savings from nursery/floral producers in these counties, and others, have been identified as a potential source of broad conservation strategies to offset unmet needs. Without the necessary data, water use for the GREEN industry, as well as potential water savings will be based on estimates, which may or may not accurately depict the status of these issues.

How can you participate?
On-Line Survey:
To ensure the future availability of high quality irrigation water, the Texas nursery/floral industry must work toward establishing baseline data for long-term water use planning. Your participation in this On-Line Water Use Survey will assist in this important effort. You can access the survey at:
http://aggie-horticulture.tamu.edu/greenhouse/twdb/survey.html

On-Line Analysis:
Understanding the factors that contribute to water conservation and contamination can greatly help producers manage these problems. An important step in this process is to evaluate carefully your growing operation to identify potential areas where improvements may be made. This information can then be used to develop short and long term management tactics to conserve water, reduce irrigation runoff, and protect our valuable natural resources.
The questions posed in the On-Line Analysis cover many of the basic factors to be considered when evaluating water management. Obviously, not all of these questions will pertain to every growing operation. Also there may be additional factors to consider which are not addressed in this format. Participants are encouraged to answer each question in a way that most accurately describes their operations. Based on this input participants will receive an assessment summary report which provides a conservation/contamination estimate and recommends the implementation of appropriate BMPs. You can access the water analysis site at:

http://aggie.horticulture.tamu.edu/greenhouse/twdb/auditform.html

**Water Conservation Field Days:**
Three field days will be conducted to provide participants with an opportunity to see the latest in water conservation practices and technology. There will be a variety of hands-on demonstrations to provide additional information on water conservation. Participants will also have the opportunity to review the On-Line Water Use Survey, Water Use Assessment Tool and publications relating to water conservation for nursery/floral producers. There is no admission fee to attend any of these events. Lunch will be provided, so we ask that you pre-register to assist in planning (only those that pre-register will be guaranteed a meal).

**Field Day Locations and Times**

Chamblees Nursery - Tyler, TX  
10:00 am - 2:00 pm  
September 8, 2005

Mortellaro’s Nursery - Schertz, TX  
10:00 am - 2:00 pm  
September 22, 2005

Hines Wholesale Nursery - Brookshire, TX  
10:00 am - 2:00 pm  
October 6, 2000

**For more information contact:**
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4.5.2 NURSERY PRODUCTION SYSTEMS

A. Applicability
This BMP is applicable to irrigation of nursery crops and agricultural producers that grow nursery crops.

B. Description
This BMP considers the design of the irrigation system used for distribution and application of irrigation water to field, container, and greenhouse grown nursery plants. Improved efficiency of water use in the production of nursery crops includes the following practices:

1) Irrigation System Design and Management
   a. Scheduling irrigation according to crop needs and growing-medium water depletion. Watering requirements will vary and should be adjusted based on time of year, weather, methods of storage and type and stage of the plant (e.g., dormancy). Plants need less water during cool, rainy weather than during hot, dry, windy weather.
   b. Upgrading irrigation equipment to improve application efficiency. For example, a computerized irrigation scheduler using a drip system can reduce overwatering and excessive leaching compared to an overhead system.
   c. Plugging sprinkler heads that are not watering plants, keeping sprinkler heads as low as possible to the plants, and use of the largest appropriate water droplet size to reduce irrigation time.
   e. When using programmable irrigation booms, travel rate and flow rates should be adjusted to specific crop needs.
   f. Use of sub-irrigation systems where appropriate, using ebb and flood or capillary mat irrigation technologies with water capture and reuse systems.

2) Plant Media and Management
   a. Grouping plants together that have the same water requirements (i.e., use hydrozoning).
   b. When ball-and-burlapped stock and containerized stock are received, they should be kept out of the wind and sun. Ideally, balls should be covered with moisture-retaining materials such as sawdust or wood chips if stock will be stored for a long time.
   c. Knowing characteristics of the application site, including soil type and depth to groundwater under the greenhouse or nursery.
   d. Spacing containers under fixed overhead irrigation to maximize plant irrigation and reduce waste between containers.
   e. Minimizing leaching from containers or pulse-irrigate containers. Many textbooks recommend leaching greenhouse and nursery crops to 10 percent excess. This rate can be reduced to close to zero by reducing fertilizer rates and closely monitoring the electrical conductivity or the root substrate.
C. Implementation
Many operational procedures and controls to improve water use efficiency of the nursery operations should be implemented simply as a matter of good practice. Implementation of this BMP consists of the following actions:

1) Perform a water efficiency audit of the nursery facility to identify areas of improvement for water savings and optimization of water use. The audit should review all aspects of operations including types of plants and specific water requirements, growing medium characteristics, and the irrigation system.

2) Implement appropriate water efficiency practices, including:
   • Design of the irrigation system such that water can be delivered to different zones at different application rates and for different durations.
   • Upgrading or modernization of irrigation system.
   • Organization of plants by water use.
   • Programming of irrigation system controllers for optimal water use.

D. Schedule
The time required to implement one or more of the above practices depends on the size and extent of the nursery operation and which conservation practices are to be implemented. Implementation of some of the above practices can be done in less than a week (programming of irrigation controllers, replacement of sprinkler nozzles, scheduling irrigations, etc.) to several months (installation of a new irrigation system or water recovery and reuse system).

E. Scope
Nursery production systems vary in extent from small (less than 1 acre) operations to multi-acre farms and greenhouses. The applicability of each of the above practices must be customized for the specific requirements of each Nursery Production System. Some of the above practices may be not be cost effective for smaller operations. Larger operations may select to implement all of the above practices.

F. Documentation
The following information can be used to document implementation of this BMP:
   • Description of irrigation techniques and water zones;
   • Description of mulching practices and soil amendments used;
   • Description of the irrigation and water recovery and reuse system; and
   • Water use records for the periods both before and after implementation of water efficient practices.

G. Determination of Water Savings
Determination of the quantity of water saved by implementing this BMP must be determined specific to each nursery production system and is dependent on the amount of water used by the existing system and which conservation practices are currently implemented by the producer. Water use records prior to and after implementation of one or more of the above practices can be used to determine the amount of water saved.

H. Cost-Effectiveness Considerations
The cost-effectiveness of implementing one or more of the above practices must be analyzed for each nursery production system. The cost ranges from minimal (for reprogramming irrigation controllers, changing sprinkler heads, etc.) to significant (installation of water recovery and reuse system, upgrading or replacement of irrigation system, etc.). Some basic operational practices should be corrected without a cost-effectiveness analysis.
Calculating Aeration, Drainage & Water Holding Characteristics:

Maximizing the efficiency of an irrigation system can be extremely complicated. Many factors must be taken into consideration in determining how best to manage the application of supplemental irrigation water. Environmental conditions, delivery and application system(s), plant type/size, container size/shape, water quality and much more all play an important role in the decision making process. The aeration, drainage and water holding capacity of the growing substrate are also key elements affecting irrigation management. However, growers rarely measure these factors to determine their impact on water use and plant growth.

The following procedure is a quick method for evaluating the aeration and water holding characteristics of any type of container growing substrate.

- Select the substrate and container size you plan on evaluating:

  NOTE: Each substrate/substrate combination will have unique properties and must be evaluated separately. Container size and shape affect aeration and water holding characteristics. You should replicate this procedure a minimum of 3 times for each container/substrate combination.

- Place a piece of duct tape over the drain holes of the selected container(s).

- Fill the container(s) with the selected substrate.

  NOTE: Initial substrate moisture content and compaction will impact water holding/ aeration characteristics. Be consistent.

- Fill a graduated cylinder (if you have access to one) with water and note the initial volume.

- Slowly pour the water in to the container until you see it reach the surface of the substrate.

  NOTE: You must do this slowly, allowing displaced air to bubble from the surface. If you have to refill the cylinder keep track of the total volume of water used.

- Enter the volume of water poured in on line A of the work sheet.

- Place the saturated container over a bucket, remove the duct tape from the drain holes and carefully collect all of the water that drains out (this can be challenging with larger size containers).

  NOTE: Do not squeeze the container or press on the substrate to force water out of the container.

- Enter the volume of water that drained from the container on line B of the work sheet.
Work Sheet/Calculations:

A. _______________________________ = Total porosity

B. _______________________________ = Air Space at saturation

C. Water retention = A - B _______________________________

D. \( \frac{B \times 100}{A} \) = Percent air space at saturation ________________________________

E. \( \frac{C \times 100}{A} \) = Percent water retention ________________________________

Container media for nursery crops typically consist of 50% - 60% air space at saturation.

Monitoring the Quality of Irrigation Water

Irrigation water is a key factor in the production of nursery and greenhouse crops. Therefore it is important to monitor quality standards on a frequent basis to avoid potential problems.

Often growers are unfamiliar with the many determinations that are made on a routine water test. This also makes interpretation of the results somewhat difficult. The following is a brief summary of these quality factors, as well as guidelines which may be used to determine their effect on plant growth.

*Electrical Conductivity* (EC) is a measure of the total salt content of water based on the flow of electrical current through the sample. The higher the salt content, the greater the flow of electrical current. EC is measured in mho/cm, which is the opposite of ohms of electrical resistance. Since the conductivity of most water is very low, EC is generally reported in thousandths of a mho or millimhos/cc.

*Carbonate + Bicarbonate* \((\text{CO}_3^+ \text{HCO}_3^-)\) are actually salts of carbonic acid (the acid formed when carbon dioxide dissolves in water). When in combination with calcium and/or magnesium \((\text{CaCO}_3, \text{MgCO}_3)\) there is an alkalizing effect. This is generally mild because they are slightly soluble salts of moderately strong bases and weak acids. A stronger alkalizing effect may occur in the presence of sodium \((\text{Na}_2\text{CO}_3)\) because this is a highly soluble salt of a strong base and weak acid. Carbonates and bicarbonates are reported in milliequivalents/liter.

*Calcium and Magnesium* \((\text{Ca}, \text{Mg})\) are cations (positively charged ions) which are present in water. In most cases the sum of Ca and Mg are reported in milliequivalents/liter. Together Ca + Mg may be used to establish the relationship to total salinity and to estimate the sodium hazard.

*Sodium* \((\text{Na})\) is another cation occurring in most irrigation water. Along with Ca and Mg, Na is present in total amounts usually exceeding 0.1%. Sodium is often responsible for salinity problems when linked to chloride \((\text{Cl})\) and sulfide \((\text{SO}_4^-)\) but seldom from Ca or Mg. Sodium is expressed in terms of the sodium absorption ratio (SAR) calculated as follows:

\[
\text{SAR} = \sqrt{\frac{\text{Na}^+}{\frac{1}{2} \left(\text{Ca}^++\text{Mg}^+\right)}
\]

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Chloride (Cl) is an anion (negatively charged ion) frequently occurring in irrigation water. Cl determinations are used to establish the relationship to total acidity as well as to indicate possible toxicities to sensitive crops.

Acidity/Alkalinity (pH) acids when mixed with water ionize into hydrogen ions (H+) and associated anions. The stronger the acid the greater the amount of ionization. Weak acids (such as those in irrigation water) generally ionize to less than 1.0%. The H⁺ ion activity of these acids is stated in terms of the logarithm of the reciprocal of H⁺ ion activity or pH.

Interpreting Water Quality
The quality of irrigation water is dependent on total salt content, the nature of salts present in solution and the proportion of Na to Ca, Mg, bicarbonates and other cations. The following table presents guidelines on the interpretation of the water quality factors.

Table 1. Water quality standards for the production of greenhouse and nursery crops.

<table>
<thead>
<tr>
<th>Quality</th>
<th>Electrical Conductivity (millimhos)</th>
<th>Total Salts (ppm)</th>
<th>Sodium (% of Total Salts)</th>
<th>SAR</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>0.25</td>
<td>175</td>
<td>20</td>
<td>3</td>
<td>6.5</td>
</tr>
<tr>
<td>Good</td>
<td>0.25 - 0.75</td>
<td>175 - 525</td>
<td>20 - 40</td>
<td>3 - 5</td>
<td>6.5 - 6.8</td>
</tr>
<tr>
<td>Permissible</td>
<td>0.75 - 2.0</td>
<td>525 - 1400</td>
<td>40 - 60</td>
<td>5 - 10</td>
<td>6.8 - 7.0</td>
</tr>
<tr>
<td>Doubtful</td>
<td>2.0 - 3.0</td>
<td>1400 - 2100</td>
<td>60 - 80</td>
<td>10 - 15</td>
<td>7.0 - 8.0</td>
</tr>
<tr>
<td>Unsuitable</td>
<td>&gt;3.0</td>
<td>&gt;2100</td>
<td>&gt;80</td>
<td>&gt;15</td>
<td>&gt;8.0</td>
</tr>
</tbody>
</table>

For approximate conversion of EC to parts per million use the following calculations:

For Millimhos:

\[
\text{ppm} = (\text{EC} \times 10^{-3}) \times 670
\]

For Micromhos:

\[
\text{ppm} = (\text{EC} \times 10^{-6}) \times 0.67
\]

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