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Floral Notes Newsletter

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MFGA Summer Meeting

Thursday August 10

Starting with Garden Trials Tours at Cavicchio Greenhouses and J.P. Bartlett Co.

Travel to Massachusetts Horticulture Society Elm Bank for Tour of MFGA Garden trials followed by a Speakers Program and Lobster clam bake.

Irrigating Greenhouse Crops

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Efficient irrigation of greenhouse crops is challenging because of the number of variables that can impact plant water use and efficiency of irrigation applications. Water is used by plants for cooling via transpiration, to maintain turgor pressure giving non-woody plants stability and allowing for cell enlargement, for metabolic activities including photosynthesis, and for transport of nutrients. Irrigation also helps to control fertilizer salt build up in container production via leaching.

Factors Affecting Irrigation Applications

The amount of water needed by a crop depends on both plant and environmental factors and changes over the production cycle and on a day-to-day basis. Plant factors that contribute to plant water needs include plant size or the age of the plant, the leaf area (both of an individual leaf and total numbers of leaves on the plant), the rooting depth, and the transpiration rate of the plant. Water needs can also be impacted by the plant canopy and its interaction with irrigation applications. For example, some crops like many *Hosta* spp. have a vase shape that helps funnel water that lands on leaf surfaces towards the growing media surface. The canopies of other crops, such as *Chrysanthemum* spp., may direct any water that lands on leaf surfaces away from the container where it cannot be used by the plant. The availability of water can also influence plant water use because plants can reduce water use in times of drought or water stress.

Solar radiation (light), wind, and temperature, and relative humidity (amount of water vapor in the air) contribute to daily plant water needs. Water moves through plants and is transpired because of a water potential gradient from the soil (high water potential) to the atmosphere (low water potential). This gradient is influenced by humidity. Humidity is the amount of water held in the air compared to the amount of water the air can hold and is normally expressed as a percentage. Humidity is inversely related to air temperature. This is because the maximum amount of water vapor that can be help in the air increases with increasing temperature; whereas the actual amount of water vapor in the air does not change due to temperature. What this means is that as air temperatures rise midday, humidity decreases leading to higher daytime transpiration rates.

Water moves from leaves to the atmosphere due to a vapor pressure gradient between the intercellular leaf spaces and the air outside of the leaf. This is the major driving force of transpiration. The movement of water vapor from inside the leaf to outside can be reduced by plant factors including hairs and waxy cuticles. Wind can cause a disruption of the boundary layer along leaf surfaces increasing transpiration.

Various aspects of production also can impact how plants should be irrigated and plant water needs. The growing media developed for container plant production have been designed to be lightweight and have low water holding capacities requiring frequent irrigation. Many of the components of growing media have hydrophobic properties and can be difficult to wet when they become dry. The components of a media will also determine the pore sizes which impact air space and water holding capacity.

Container height affects the air and water characteristics of substrates in containers. There is increased drainage as container height increases due to gravity. Shallow containers can have a lower amount of air space and can be more likely to have waterlogging if not irrigated properly. The type of container being used can also impact water availability. Some of the newer compostable and biodegradable containers such as coir fiber and paper pulp containers have porous sidewalls and can have higher water requirements. Water requirements can be 1.5.-2.5x higher than plastic pots.

Air movement in the greenhouse from fans or ventilation can also cause drying of some areas, creating pockets that need additional irrigation. Greenhouse structures can lead to interference with overhead irrigation, leading to reduced uniformity of applications.

Irrigation Applications

Traditionally irrigation practices have erred on the side of too much vs. too little water to avoid negatively impacting plant growth. This has led to frequent irrigation applications, over-fertilization, and fertilizer leaching. There are four general methods that can be utilized for determining when to irrigate: 1) in response to stress symptoms, 2) based on weight, 3) based on time (whether automated or by hand), 4) and based on data. Irrigating in response to plant stress symptoms can be very challenging because you risk impacting growth and/or plant quality. Irrigators also need to be familiar with stress symptoms for all crops. Gravimetric, or weight based applications, depend on the expertise of the irrigator and their familiarity with the various media being utilized in production. Timed applications ensure that irrigation occurs on a scheduled basis, but frequently are not in response to actual plant water needs or environmental conditions. Data based irrigation allows for informed decisions based on factors that influence plant water use. Sensors can be used to provide data on soil moisture, light intensity, wind, air temperature, and relative humidity. This information can be used to automate irrigation or make management decisions.

Best management practices have been developed to help improve irrigation application efficiency. Some practices include:

- Group plant by water needs
- Consolidate plants within an irrigation zone
- Keep leaching fractions no more than 20%
- Perform irrigation audits regularly: check for clogs/build-up, reduce variability, assess container spacing, check uniformity
- Improve applications by using cyclic irrigation of drip irrigation
- Base irrigation decisions on information such as environmental conditions, media water status, or changing plant needs
- watering slowly to allow time for infiltration
- Water the media not the foliage using a uniform gentle flow

Pros and Cons of Manual and Automated Irrigation

	Pros	Cons
Manual	• Less initial investment in equipment • Opportunity to look at every plant and adjust water per plant needs	• Requires experience to be done efficiently • Labor intensive • Often wasteful • Wetting of foliage can lead to foliar diseases • Uniformity dependent on applicator
Automated	• Reduced labor • Reduced potential for human error • More consistent	• Higher initial investment • Some technology can require alteration of existing systems
Drip Irrigation	• Directed and uniform applications • Doesn't wet foliage	• Can be challenging if multiple crops in same irrigation zone • Can be variable in number of emitters, space, etc. needed
Ebb-and-flood	• Allows for multiple container sizes • Placement easily changed • Uniform applications • Don't wet foliage • Recycle water	• Water needs contained and treated • Recycling of water can lead to the spread of diseases if not properly managed
Overhead	• Allows for multiple container sizes • Placement easily changed	• Wetting of foliage • Poor uniformity – greenhouse structures, not maintaining system
Boom Irrigation	• High level of control • Directed applications	• Installation costs • May require changes in infrastructure

Developing guidelines based on the visual appearance of the media, weight of the plants, evapotranspiration, or the water content of the media can help improve efficiency, especially when there are multiple people in charge of irrigation.

References

Bartok, Jr., J. 2009. Boom Irrigation Systems. https://ag.umass.edu/greenhouse-floriculture/fact-sheets/boom-irrigation-systems

Cox. D. Subirrigation for Greenhouse Crops. https://ag.umass.edu/greenhouse-floriculture/fact-sheets/subirrigation-for-greenhouse-crops

Krug, B. 2014. Master the Art of Watering. Greenhouse Grower. Sept. 26, 2014. http://www.greenhousegrower.com/production/plant-culture/master-the-art-of-watering/

Garden Mums for Fall

There are a variety of ways to produce garden mums using different pinching and planting strategies. Traditional garden mum production schedules involve planting the end of May or early June and pinching plants two times. The first pinch is given within two weeks of transplanting when roots of the cutting reach the bottom and sides of the container and the tops show 1.5-to 2.0 inches of new growth. The second pinch is given when the axillary shoots from the first pinch are 3 to 4 inches long, usually three weeks later in late June or early July, but prior to July 20th.

New varieties have been bred to branch naturally and produce many branches at flowering. As a result, other production schedules for later crops have been developed include planting later and using a single pinch or no pinch for actively growing plants. Also, for convenience, some growers are providing a single pinch to their rooted cuttings when plants are still in the plug trays instead of after transplanting.

If no pinch is new to you, trial it on a small scale, before devoting the entire crop to this growing method. This technique is only successful if planting actively growing cuttings and the young plants are watered and fertilized for active growth, especially during the first few weeks of production. It is important to prevent plants from becoming water stressed which results in hardened growth, fewer breaks and/or premature flower budding. Use the no pinch method on those cultivars that have been bred to do well when grown this way.

Chrysanthemums are short-day plants. Both flower initiation and development of the flower buds occur more rapidly under short days than long days. However, temperature has a greater influence than day-length on flowering of garden mums. In June, with several cool nights in a row, garden mums can initiate buds prematurely which results in early flowering on short plants. If premature terminal budding occurs, buds can be pinched off, and adequate water and additional fertilizer supplied to allow plants to grow larger and flower later. Some growers leave the buds on the plants and fertilize heavy with the expectation that the vegetative growth will by-pass the budded growth. The plants often continue to grow and develop into a quality fall crop. In some cases plants become uneven with two-tiered appearance. Growers have reported that the plant response varies according to the variety.

References

Garden Mums, UMass Extension (*with links to guides and resources*)
Add Fall Color with No-Pinch Garden Mums, University of New Hampshire Extension
Garden Mum Production for Fall Sales, University of Kentucky

Tina Smith, UMass Extension. Reviewed by Leanne Pundt, UConn Extension and Douglas Cox, UMass Stockbridge School of Agriculture *Greenhouse Update* June 9, 2016

Photovoltaic Solar Electricity for Greenhouses

John W. Bartok, Jr., Agricultural Engineer, Emeritus Extension Professor, Univ .of Connecticut

Is it time to consider solar power? Will all greenhouses become electricity generators some day? Improvements in photovoltaic electricity systems are making them more attractive for greenhouses. Photovoltaic systems with efficiencies as high as 40% are now available at a cost that results in a reasonable payback. Also systems that can be integrated with the greenhouse are being installed. Let's look at some of the options.

Photovoltaic panels can generate 200 to 300 kilowatts of electricity per year.

It would take a very large system to provide all the energy needs for a typical greenhouse but supplying the electricity needs is definitely feasible. First, we need to establish how much power the greenhouse requires. From my analysis in doing energy audits, the typical greenhouse uses between 1 and 2 kilowatt hours of electricity per square foot of floor area per year (kWh/sq ft-yr).

If conservation measures, such as roof and sidewall vents, wall insulation, energy screens, accurate controls and a boiler system rather and furnaces or unit heaters, electricity use is decreased to a minimum. Ventilating fans and hot air furnaces use over ½ kWh/sq ft-yr each if the greenhouse is operated year-round. Vents and boiler systems reduce this by 75% or more.

Depending on the efficiency of the solar collector, the location of the collector and the area of the U.S where the greenhouse is located, a PV system will generate from 10 to 35 kWh/sq ft-yr. If you operate 10,000 sq ft of greenhouse space that uses 1 kWh/sq ft-yr and have a collector system that provides 25 kWh/sq ft-yr you would need 27- 3' x 5' solar panels to supply your electricity needs.

There are two basic types of PV systems, one that stores electricity in batteries and the other that connects to the utility power grid. Grid connected systems are the most common for greenhouses. When excess power is being generated, the grid absorbs this. At night when there is no generation, the grid supplies the needed power. This is net metering. As PV systems supply direct current, it has to be converted to alternating current to operate the greenhouse equipment.

Photovoltaic systems can be ground mounted but these take up considerable land area. Another option is to mount them on an adjacent building such as the headhouse or storage building. As most panels are opaque and block light they cannot be mounted on the greenhouse without blocking light needed for plant growth.

Poly-silicone, thin film materials are becoming available that allow light through. This material can be placed between two layers of glass or plastic and then used as the glazing on the greenhouse. As it reduces light transmission about 30%, only part of the roof is covered with the PV panels. MaineAsia LLC along with the Maine Sustainable Agriculture Society has a grant to build a couple of greenhouses with this technology.

An inverter is needed to convert the DC power generated to AC power to feed the power grid or for collection operate equipment.

Another company, Solaria Corporation in Fremont CA has developed photovoltaic modules that alter the light spectrum by converting some of the sunlight to power with the rest remaining for plant growth. The pink light transmitted increases production while reducing disease problems.

ULMA Agricola in Spain has developed greenhouse mounted, optical lens based PV modules that allow light through during cloudy weather and divert it to solar cells when it is sunny.

One area that hasn't been explored much is making energy/shade screens into solar collectors. When a screen is extended to provide shade it could provide a large area.

One further development that is being researched is a clear spray on PV material that will generate electricity without much reduction in light transmission. This could make all greenhouses electricity generators. The future looks bright for converting sunlight into electricity. Photovoltaic systems could help to reduce greenhouse operating costs.

How to Maintain the Quality of Plants in the Retail Area

Geoffrey Njue, Extension Specialist, UMass Extension, Waltham

In the busy spring season, it is easy to forget to care for plants after moving them into the retail area. It is important to continue to pay attention to the plants to keep them looking good in the retail area. The hope always is to sell plants quickly after moving to the retail area. However, due to weather or other circumstances some plants stay for prolonged periods in the retail area, so it is important to respond proactively to maintain quality of plants. Here are some maintenance practices to pay attention to.

Watering the plants
Inadequate watering is one of the main causes of poor plant quality and loss in the retail area. Insufficient watering is usually common in the retail area leading to dry up and wilt. Plants that have undergone severe wilting may not always recover. To prevent loss of plant quality in the retail area assign a trained staff to inspect plants regularly and water as needed. Plants should be watered regularly and gently to maintain quality. Make sure the substrate is fully saturated when watering. Watering should be completed well before dark so plants will dry off preventing foliar diseases. Watch the weather to determine the need for watering. If cloudy weather is expected, minimize watering to avoid overwatering. Overwatered plants can be prone to root rot diseases.

Fertilizing plants
Plants that will be purchased quickly do not require Fertilizer in the retail area. The most common nutrient deficiency that appear on plants in the retail area is nitrogen deficiency. This is because the plants are either not fertilized enough or they are not fertilized at all. Nitrogen deficiency shows up as yellowing of lower leaves. Options for fertilizing plants include the use of water-soluble fertilizers or top dressing with a

controlled release fertilizer. If using water soluble fertilizer in retail area a portable injector would be useful. If possible fertilizer with every irrigation. Fertilizer rates in a retail setting should be reduced compared to production because the goal is to maintain plants and not to encourage growth. The use of controlled release fertilizers in a retail setting is a good choice because they do not need an injector and they continue to provide nutrition to the plants after the customers take the plants home.

Nutrient disorders

The other common nutrient problem in retail setting is iron deficiency on iron inefficient plants such as petunia and calibrachoa due to high substrate pH, and iron toxicity on iron efficient plants such as geranium due to low substrate pH. To prevent iron deficiency and toxicity in the retail area use fertilizer that is neither potentially acidic nor potentially basic but neutral such as 17-5-17. Be aware that the source of nitrogen in the fertilizer affects the pH of the substrate. Fertilizers that provide N primarily with ammonium (NH_4-N) will lower the pH because H^+ ions are released when plant roots absorb ammonium ($NH4^+$) ions. Fertilizers that provide N primarily with nitrate (NO_3^-N) will increase the pH because OH^- ions are released when plant roots absorb nitrate (NO_3^-) ions.

Pest management

Managing pests in a retail setting can be very challenging because the retail area is open to the public long hours 7 days a week. Integrated pest management (IPM) practices are very important in managing pests in the retail area. The following are important IPM practices for managing pests in the retail area:

> **Inspecting plants before moving them into the retail area.** Inspect all incoming shipments of plants, and plants from the production area before bringing them into the retail area. If any sign of insect activity or disease symptom is found quarantine the plants and treat them. Do not bring them into the retail area until they are completely clean and free of disease or insect pests.
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> **Monitoring plants for disease symptoms and insect pests.** Develop a regular monitoring program using sticky cards and regular plant inspection. Early detection will result in better pest control. If only a few plants are infected, they can be moved out or into a production house for treatment.
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> **Spacing plants.** Plants should be spaced so that they are attractive to customers and provide sufficient spacing to promote air circulation to help prevent foliar diseases. Promptly replace any plants that show symptoms of disease or insect pests.
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> **Pest control.** Options of pest control in a retail setting include:
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>> **Biological control using natural enemies.** This is easier for growers already using biological control in the production area because plants will not have harmful pesticide residues.
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>> **Pesticides.** When choosing a pesticide consider crops listed on the label and the restricted entry interval (REI). The REI will influence which pesticide to choose for use in a retail setting. Be sure to read and follow the pesticide label.

For further information, please see the following fact sheets: Caring for plants in retail: http://ag.umass.edu/greenhouse-floriculture/fact-sheets/caring-for-plants-in-retail-setting

Krug, B. Don't let your plants go hungry in retail: http://e-gro.org/pdf/338.pdf

Pundt, L. and R. Raudales. Maintaining high quality plants in a retail setting: http://www.e-gro.org/pdf/2016_531.pdf