UMass Extension

CHECKLIST
WATER: SUPPLY AND SOURCES

- ✓ Determine the amount of water needed based on crops grown, weather conditions, time of year and the environment control system.

- ✓ Adapt low usage irrigation systems to extend a limited water supply such as zoning and low flow wells.

- ✓ Samples of a potential water supply should be sent to an irrigation water testing laboratory for analysis.

Water Sources

- ✓ **Drilled wells –** Deep wells are best. Location may require local and state regulations and permits.

- ✓ **Surface water –** Filters may be needed. High sodium and chloride levels may be a problem.

- ✓ **Drainage ponds** – Commonly contain fertilizers or chemicals. Algae growth may be a concern.

- ✓ **Rain water –** Can be collected from greenhouses or roofs without contacting the ground. It is a clean source of water except for any debris that gets into the system.

- ✓ **Municipal water –** The cost and quality are typically high. May contain additives such as fluoride, chlorine or sodium.

WATER: SUPPLY AND SOURCES

Water Supply

Water is a major factor in successful production of greenhouse plants. An adequate water supply is needed for irrigation, pesticide application, evaporative cooling (if applicable), growing media preparation and clean-up.

Plants require an adequate supply of moisture for optimum growth which is affected by many variables. The amount of water needed depends on the area to be watered, crops grown, weather conditions time of year and the environment control system. The design for the water supply needs to be made for the peak use time of the year. A rule of thumb is to have available 0.3 to 0.4 gallons/square foot of growing area per day as a peak use rate for the warmest day. For example a 30’ x 100’ greenhouse with 2400 square feet of benches would require a peak use rate of 720 to 960 gallons/day. The following factors can increase or decrease the amount of water needed:

- **Solar radiation.** The level of radiation that reaches the plants is reduced by 10% to 40% due to the glazing and the structural members in the greenhouse. This reduces the transpiration.
- **Shading.** The use of shading outside or inside will reduce the radiation level on the plants. Depending on the level of shade, this will reduce evapotranspiration and therefore water needs.
- **Air movement**. Fan ventilation and HAF systems increase the rate of evapotranspiration. Depending on location and nearby greenhouses or other buildings, sidewall vents and open-roof designs can also have an influence. A 5 miles/hour breeze can increase evapotranspiration by 20%.
- **Type and size of the plants.** Seedlings or small potted plants require less water than a full-grown tomato or cucumber crop. A large root mass or heavy leaf canopy will increase water needs.
- **Type of irrigation system**. Only 20% of the irrigation water applied with an overhead sprinkler system may reach the soil in a potted plant crop with a large foliar canopy. In-pot drips systems are much more efficient as all the water applied with an in-pot drip system gets to the soil. Subirrigation systems such as ebb and flood systems, flooded floors and hydroponics conserve water by recycling and reusing the excess water.
- **Leaching**. Traditionally, the recommendation that at least 10% of the water applied be allowed to leach out to remove excess fertilizer salts increases water usage. Often leaching accounts for a much higher percentage and can increase water needs significantly. The type of growing mix used also affects the amount of water holding capacity and therefore the frequency of watering.

Extending a limited water supply

Water supplies can be extended by several methods. Most common is adapting low usage irrigation systems. Zoning, applying the water to one area or section of plants at a time, will allow a low flow water source to irrigate a larger number of plants. Zones can be sized to utilize the flow from a well or municipal source so that irrigation takes place all day long.

Low flow wells can be set up to be pumped to a storage tank over a many hours. Water from the tank is then used to irrigate plants during the daylight hours.

Collection of rainwater to supplement a well or surface system is also possible. This works best with a gutter-connected greenhouse where the water from the downspouts is piped to an above ground or below ground storage tank. See section on rainwater.

From a conservation standpoint, keeping the piping system in good repair is important. A leak of one drop per second wastes over 113 gallons of water per month.

Water Sources
Characteristics of irrigation water that define its quality vary with the source of the water. There are regional differences in water characteristics, based mainly on geology and climate. There may also be great differences in the quality of water available on a local level depending on whether the source is from above ground (rivers and ponds) or from groundwater aquifers with varying geology, and whether the water has been chemically treated. Municipal system water and deep wells generally provide the best water source for greenhouse operations. Chemical treatment of water may be required when pollutants such as iron, sodium, dissolved calcium and magnesium or bicarbonates are present. Surface water such as ponds and streams may have more particulate matter such as suspended soil particles, leaves algae or weeds that needs to be filtered out.

A sample of a potential water supply should be sent to an irrigation water testing laboratory for analysis.

The main sources for irrigation water are groundwater from wells, surface water, drainage ponds, rain and municipal water.

Drilled wells are a clean source of water for many greenhouse operations however, the water yield from drilled wells is usually limited.

Groundwater is found in aquifers that are located below the earth surface. As rainfall occurs, some of it evaporates, some of it is removed by plant transpiration and the remaining water filters down through the topsoil and flows into sand, gravel and fractured rock. It reaches a depth where all the pore spaces are filled. This saturated zone is call the aquifer.

The flow of water from a well depends on the permeability and size of the aquifer, its recharge area and the amount of rainfall. A well in one location may provide a very low yield, while another area, may provide a high water yield. In most areas, well drillers keep an accurate record of the depth and yield of wells they drill. Groundwater quality varies due to the parent material. For example, in the Berkshires of western Massachusetts groundwater is often drawn from limestone aquifers. Even for one site, the location and depth of the well can have an important effect on water quality. Elemental content and bicarbonate levels can also change with the seasons of the year, and the amount of pumping from the wells.

Since 1974, well drillers have been required to file a Water Well Completion Report with the local board of health, the well owner and the Massachusetts Department of Environmental Management (DEM). This report provides data on the well's location and depth, the drilling method used, the material it draws water from, and results of water quality and pump tests. The well driller should be registered with the DEM and install the well according to local board of health regulations. There is usually a minimum distance from a septic system or sewer and there may be a minimum distance to a property line.

Surface water includes streams, rivers, lakes and ponds which are dependent on runoff from adjacent land or from ground water springs. These are dependent on rainfall rates that vary from year to year.

Surface water is subject to contamination from sources such as sediment, chemicals and plant growth. High levels of particles can reduce the life of pumps and clog irrigation systems and multiple filters may be required. It is also possible that surface waters can become contaminated with road salt, industrial, agricultural chemicals, algae and plant pathogens.

Drainage ponds are usually a combination of rain water and run-off. Drainage ponds commonly contain fertilizers or other agricultural chemicals. Because of the size and lack of aeration, biological conditions such as algal growth may be a concern.

Rain water can be collected from greenhouses or building roofs without contacting the ground and held in a concrete cistern, fiberglass or polyethylene tank, water silo or other holding tank. It is clean except for any debris that gets into the system. Rain water will be very low in elemental or chemical contamination unless there is industrial air pollution or fallout on the roofs. The pH of collected rain may be low (4.0 – 5.0) but is not considered detrimental to crops because it is not buffered (does not resist change in pH) and changes readily. Rain water is an excellent and underutilized source of irrigation water.

A 1" rainfall on an acre of greenhouse amounts to 27,100 gallons. A common yield is about 65% with losses due to evaporation, wind, leakage of piping system and diversion of the first few minutes of the rainfall to remove debris. To calculate the quantity in gallons that can be collected, multiply the square feet of greenhouse building floor (footprint) by 0.4.

A basic system consists of a storage tank, roof washer, inflow pipes, overflow pipes and a diverter to redirect the excess water when the tank is full. Concrete or plastic tanks can be used but are usually limited to about 15,000 gallons. Corrugated steel tanks can be built to almost any capacity as they are delivered in preformed panels and assembled on site. Before the water is collected for irrigation, a device called a roof washer is normally used to divert the first flush of water that is collected to remove debris from the water. Also an overflow is needed to handle excess water. The excess water is diverted to a drainage area where it will not flood neighboring property.

Once rainwater is collected, it can be distributed to the greenhouses through the normal irrigation system.

Municipal water includes water supplied by city, county or municipality. Either, ground, rain, and/or surface water may be used. The cost and quality are typically high since much of the water is for residential use and drinking water and is treated. The key concerns are whether supply is guaranteed in times of shortages and what water treatment procedures are used that may influence plant growth. Municipal water may have fluoride and/or chlorine added at rates which is not a problem for most crops. Occasionally, sodium compounds are added to treat hard water.

References

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