



Nursery & Garden Industry
Queensland

Introduction to Bottom Watering Irrigation Systems

Bottom watering systems work on the principle that water will move upward through holes in the bottom of the pot and into the growing media by capillary action. This makes these systems very water efficient, but their advantages and disadvantages need to be weighed carefully as they aren't suitable for growing all crops.

Advantages:

- Use the least amount of water of all irrigation systems.
- Almost no leaching of the growing media, meaning quality crops can be grown using at least half the amount of fertiliser.
- Allow efficient use of liquid fertiliser.
- Reduced levels of nutrients in runoff water.
- These systems can offer an ideal Coefficient of Uniformity (CU) and Scheduling Coefficient (SC), with the Mean Application Rate (MAR) automatically matched to the absorption rate of the growing media.
- Recirculation of water minimises runoff.
- Bottom watering systems can be designed to meet stringent environmental regulations and water efficiencies.
- Low risk of spreading pathogens.
- No water on foliage reduces foliar pathogens.
- Weeds are reduced due to high salt levels and the dry surface of the growing media.

Disadvantages:

- Small containers such as seedling trays and plugs can be easily over-watered.
- May not be suitable for tall containers or containers of more than 250 mm diameter.
- Can be more expensive to set up than a fixed overhead sprinkler system.

Management of bottom watering systems

Salt accumulation

Salts, both from applied nutrients and in the irrigation water, and not taken up by plants can accumulate in the top 10 to 15 mm of the growing



media in a pot. If high quality water is used there will be little salt added from the water supply. The use of slow-release fertilizers for all of the crops nutritional requirements is not recommended, as the fertilizer levels cannot be easily controlled. Salt accumulation can generally be managed by reducing fertiliser rates and/or by regular leaching. Before dispatching plants all salts in the top layers of the growing media should be leached out with a thorough overhead watering.

Low media pH

Bottom watering may cause low pH's in the bottom layers of the growing media. This can be caused by nitrifying bacteria feeding on the ammonium component of fertilizers. Low root media pH may contribute to heavy metal toxicity or nutrient uptake problems, e.g. aluminium toxicity.

Oxygen deficiency

Oxygen concentrations of circulating solutions are significantly lower than the optimum level due to microorganism activity in the storage tank. Trough systems usually have higher oxygen levels than bench or floor systems, and some operators inject oxygen into their solutions on ebb and flow systems.

Heavy metal toxicity

When using nutrient solutions, non-metal or painted bench surfaces and supply equipment (pumps, pipes, tanks and valves) should be used, otherwise the solution can be contaminated with heavy metals. In closed systems, contamination

with heavy metals may lead to accumulation in the pot and, combined with a lower pH in the lower layers of the pot, increase risk of toxicity from heavy metals.

Growing media

Growing media characteristics have a major influence on these systems. It is important to select a growing media that can quickly take up water by capillary action. If the growing media has a high Air Filled Porosity (AFP) capillary water movement will be virtually non-existent. Deeper containers may require a lower AFP and greater compaction.

Recycling

Disinfestation of irrigation water to minimise the spread of pathogen diseases is warranted. Care needs to be taken to disinfect the water supply before it is introduced into the system. It is important to use disease free stock to minimise the risk of introducing diseases into the system.

Other management considerations

- Hygiene practices need to be excellent with these systems to reduce the risk to crops.
- Plants need to have a well established rootsystem before being put into these irrigation systems.
- Continuous watering, or watering too frequently, encourages algal growth in trays and mats and results in too much water being lost to evaporation and drainage. Water intermittently several times/day.
- Watering frequently doesn't allow the media to dry out too much, making it easier to maintain capillary action and uniform moisture levels. This reduces the possibility the media will become difficult to re-wet, particularly in pots over 150 mm diameter.
- 150 mm diameter containers can receive almost the same amount of water through bottom watering as through overhead, although the top of the media will usually remain dry.
- These systems lend themselves well to liquid feeding and water recycling by collecting the discharge in holding sumps. As makeup water is added to holding sumps fertiliser can be injected.
- The pH can be monitored using an in-line meter and automatically corrected. The nutrient solution should be periodically analysed for nutrient composition.

- If these plants are being grown outdoors periodically flush with an overhead irrigation system to prevent surface salt build up moving down into the root zone during light rainfall events.
- Bottom watering systems require good quality water to avoid salt problems. When using high salinity water, reverse osmosis (RO) may be required to control salinity by removing salts from the incoming water source. The problem of brine discharge needs to be considered with RO water treatment systems.
- Containers over 100 mm diameter are difficult to over-water, but plugs and flats are easily over-watered.
- Capillary action needs to be maintained to enable the water to continue to move into the growing media and refill to its natural level.
- The position of holes in the pots must maximise the contact of water with the growing medium.

Water consumption rates

Bottom watering systems use significantly less water than overhead and hand watering systems. Average annual consumption for various systems are:

- Ebb and flow benches 5 ML/ha
- Flood floor systems 5 ML/ha
- Capillary mats with run to waste 7 ML/ha
- This compares to 29 ML/ha for average overhead (10 ML/ha if fully recycled) and 20-100 ML/ha for hand watering.

For further information on bottom watering systems see Nursery Industry Water Management Best Practice Guidelines 2010.

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