



Farm Water Futures - Heaton's Nursery Field Day

Irrigation Systems in Action Field Day

April 29, 2021



Glossary of Terms

MAR - Mean application rate - the rate water is applied to the growing media - BMP Bark <15 mm/hr, Bark + wetting agent <20 mm/hr, Coir <25 mm/hr.

CU - Coefficient of Uniformity - a measure of how uniform the water is applied over growing area - BMP >85%.

SC- Scheduling Coefficient - a measure of how long the system needs to run to fully irrigate the container receiving the least water in the system - BMP < 1.5.

Pulsing - Operating the system for multiple short applications to enable water to be more effectively absorbed into the growing media.

Pressure compensation - within a range of pressures an emitter's output will be the same.

Non-leak/ non-drip/ anti-drip - a function where an emitter closes off when the system stops allowing the lateral to stay full of water.

CNL - compensating non-leak emitter - drippers.

Arrow - a stake designed to regulate flow and guide water into the growing media in drip irrigation systems.

Capillary action - the tendency of water in a growing media to rise or fall as a result of surface tension.

EC - Electrical Conductivity - a measure of salts in water or growing media.

System	Microtube drippers	Capillary mat
Principle of operation	Application directly to and only on the growing media.	An absorbent material is wet using a drip system or other method. Water is taken up through the drainage holes in the container and moves through the growing media by capillary action.
Advantages	Cheap materials. Simple system. Foliage stays dry. Reduced runoff. Not affected by wind.	Simple to set up. Reduced fertiliser and water use. No drainage. Low flow rate and pressure requirements. Not affected by wind. Keeps foliage dry.
Disadvantages	Large labour requirement to install. High flow rates which exceed absorption rate of the growing media in this container size. Reducing flow rates is possible but more complicated. No non-leak or pressure compensating functionality. Unsuitable for frost mitigation.	Cost to set up - mat material and growing surface. Hygiene considerations. Unsuitable for frost mitigation. Algae growth can be a problem.
Components	Micro tube and laterals.	Absorbent material. System to wet matting, e.g., drip tape with drippers 60-70 cm apart. Complete off-the-shelf systems can be purchased.
Design considerations	Relatively high flow rates from the emitter for this container size - exceeds absorption rate of the growing media. Flow rates can be reduced through adjusting the length of dripper tube and/or operating pressure. No non-leak or pressure compensation thus reducing uniformity.	Container design to enable water to be taken in through the drainage holes. Growing media characteristics suited to capillary action. Better suited to low light and temperature and high humidity situations. Spacing of emitters to ensure mat is uniformly wet. Black perforated sheets can also help to control algae.
Management	Difficult to achieve uniform watering without excessive leaching. Short pulses will only make poor uniformity of application across the area worse.	Allow mat to dry out to reduce algae - 3-4 30 minute cycles/day. Top of the growing media stays dry reducing weed growth and leading to high EC in top layers of growing media. Reduce fertiliser rates or occasional leaching may be required to manage EC. Having the mat continuously wet will reduce plant growth rates.
Assessments	Including end bench - MAR 151 mm/hr, CU 82%, 6.6 SC. With end bench results removed MAR 156 mm/hr, CU 87.8%, SC 1.2. 100 mL/ 5.5 minutes (1L/hr).	Cannot be assessed using current methods.
Grower comments	The container is under the outlet and the tube can't be taken out with the container; quicker to place containers as the container is placed under the outlet.	Maintains high humidity around plants.
<u>Links to resources and publications -</u> https://nurseryproductionfms.com.au/download/water-management-best-practice-guidelines/	Dripper & Spray Stake Selection Tool - https://www.ngiq.asn.au/download/ngiq-dripper-spray-stake-selection-tool/	
	Technical article - https://www.ngiq.asn.au/download/drip-irrigation-design-management-2019/	Technical article - https://www.ngiq.asn.au/download/introduction-to-bottom-watering-irrigation-systems/
	Video - https://www.youtube.com/watch?v=qQbLEWvwqjo&feature=youtu.be	

System	Ebb and flow	Single dripper emitters
Principle of operation	Water floods into benches generally to ~2cm depth. Water is taken up through the drainage holes in the container and moves through the growing media by capillary action.	Application directly to and only on the growing media.
Advantages	Not affected by wind. Reduced fertiliser rates. If drainage water is recycled the only water used is what is taken up by plants. Does not wet foliage. Commonly used on flowering plants and those susceptible to foliar disease. Reduced labour costs. Equal water distribution resulting in very uniform crop. Low maintenance.	Less complicated to install than compensating non-leak (CNL) emitters. Water precisely applied. Low pressure and flow rate requirements. Foliage stays dry. Liquid fertiliser can be applied. Not affected by wind. Reduced runoff.
Disadvantages	Costly to install, particularly flood floors. Requires recycling with a form of water disinfection treatment to realise full water saving benefits. Fertiliser levels and EC need to be monitored. Unsuitable for frost mitigation. Better suited to protected cropping.	Less efficient if a low flow rate emitter not used. Dripper flow rate to match absorption rate of growing media - may be difficult to achieve. Some do not have CNL features. Lateral water movement may not be sufficient for larger containers. Unsuitable for frost mitigation.
Components	Water delivery and treatment/disinfection system if recycling. Bench trays or flood floors.	Non-pressure compensated and no non-leak drip emitter, dripper tube.
Design considerations	Container design to enable water to be taken in through the drainage holes. Growing media characteristics suited to capillary action. Bench design and incoming flow rates so all containers soak for the same amount of time. Flood control methods for manually operated systems.	Higher flow rates and high application rates at the container. The number of entry points per container may not be suitable for larger containers. Some emitters do not incorporate CNL features.
Management	High EC levels will tend to develop in upper 1/3 of container necessitating good leaching with first top water. Fertiliser rates may need to be reduced.	More difficult to achieve lateral water distribution within the growing media without significant leaching in smaller containers. Poor lateral distribution in larger containers. Pulsing may make uniformity worse.
Assessments	Cannot be assessed using current methods.	MAR 93.7 mm/hr. CU 91.8% SC 1.2
Grower comments	Best watering system ever. Easy to manage; low water use.	Put out a lot of water; drippers need to be positioned to make sure the water goes in the container.
<u>Links to resources and publications</u> - https://nurseryproductionfms.com.au/download/water-management-best-practice-guidelines/	Supplier (information provided by Powerplants) - https://staal-plast.dk/	Dripper & Spray Stake Selection Tool - https://www.ngiq.asn.au/download/ngiq-dripper-spray-stake-selection-tool/
	Technical article - https://www.ngiq.asn.au/download/introduction-to-bottom-watering-irrigation-systems/	Technical article - https://www.ngiq.asn.au/download/drip-irrigation-design-management-2019/
	Other systems (information provided by Powerplants) - https://erfgoed.com/	Video - https://www.youtube.com/watch?v=qQbLEWvwqjo&feature=youtu.be

System	Trough	Spray stakes
Principle of operation	The containers located in the troughs slow the flow of water past them allowing the water to be taken up through the drainage holes in the container and move through the growing media by capillary action.	Water sprays over the top of the growing media but only within the container.
Advantages	Growing media will only take up the water required. Reduced fertiliser rates. If drainage water is recycled the only water used is what is taken up by plants. Low maintenance. Good air flow around plants with single trough systems. Does not wet foliage. Commonly used on flowering plants and those susceptible to foliar disease. Reduced labour costs.	Water spread over the top of the container if operated at high pressures. Not significantly affected by wind.
Disadvantages	Costly to install. Requires recycling with a form of water disinfection treatment to realise full water saving benefits. Fertiliser and EC levels need to be monitored. Unsuitable for frost mitigation.	Very high application rates. High pressures and high flow rates required to work effectively. Poor uniformity. Unsuitable for frost mitigation.
Components	Trough benches and water delivery system.	Riser tube. Spray stake - can be single or multi-hole.
Design considerations	Container design to enable water to be taken in through the drainage holes. Growing media characteristics suited to capillary action. Grade of bench about 1:600.	Mean Application Rate. Which setting to use on multi-outlet stakes. High flow rates require larger delivery pipe sizes. No pressure compensation or non-leak functionality. High pressures required to operate. Low pressures result in high application rates at the point of application resulting in poor lateral distribution and large amounts of leaching.
Management	High EC can develop in which may require leaching. High EC levels will tend to develop in upper 1/3 of container necessitating good leaching with first top water. Fertiliser rates may need to be reduced. 150 mm containers irrigated for about 20 minutes and 200 mm containers for 40 minutes/irrigation.	High application rates lead to excessive leaching. High application rates cannot be managed by pulsing as this results in poor uniformity due to no non-drip functionality of these emitters.
Assessments	Cannot be assessed using current methods.	MAR 165 mm/hr. CU 80.6% SC 3.5 in a 400 mm container.
Grower comments	Cheaper form of ebb and flow.	Spreads water over the top of larger containers.
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		Video - https://www.youtube.com/watch?v=qQbLEWvwqjo&feature=youtu.be

System	Compensating Non-Leak (CNL) drippers	Inverted overhead sprinklers
Principle of operation	Application directly to and only on the growing media.	Water is forced through a nozzle and then through a spinner which throws the water away from the sprinkler. Sprinklers are in an inverted position, i.e., hanging from a structure.
Advantages	High efficiency system if set up and managed correctly. Precisely applied water significantly reduces water use and runoff. Reduced fertiliser use - can be used to apply liquid fertiliser. Foliage stays dry. Low pressure and flow rate requirements. Not wind affected.	Moderate installation cost. Wide range of emitters available. Lower maintenance. Can be used for frost mitigation.
Disadvantages	Expensive to set up. Higher maintenance requirements and costs. Requires excellent filtration. Design is critical for efficient operation. Unsuited for frost mitigation.	Affected by wind. Small changes in operating parameters can make a large difference to uniformity. Interference with nursery operations. Wet foliage may be more susceptible to disease. Less water efficient than drip and bottom watering systems.
Components	Compensating Non-leak (CNL) drip emitter, manifold, dripper tube and arrow.	Water delivery system. Sprinklers, droppers and weights (optional).
Design considerations	Absorption rate of growing media, flow rate of dripper, flow rate from arrow, number of arrows in each container for satisfactory lateral distribution, total flow rate to each container.	Design of sprinkler suited to inverted operation. Diameter or radius of throw (radial leg). Operating pressure required. Spacing of sprinklers. Height of sprinklers. Other infrastructure - posts, benches, pathways.
Management	Pulsing enables more water to be absorbed. Wetting agents may improve lateral distribution. More arrows per container improve lateral distribution but increase MAR. Do not block off arrows when plants taken out as this affects uniformity.	More affected by wind. May interfere with nursery work due to water spraying over the whole area.
Assessments	MAR 13.6 mm/hr. CU 94.4% SC 1.1 in a 250 mm container.	MAR 13.8 mm/hr. CU 82.6% SC 1.7.
Grower comments	Not currently installed at this site.	Sprinklers do not interfere with nursery operations.
<u>Links to resources and publications -</u> https://nurseryproductionfms.com.au/download/water-management-best-practice-guidelines/	Dripper & Spray Stake Selection Tool - https://www.ngiq.asn.au/download/ngiq-dripper-spray-stake-selection-tool/	Sprinkler Selection Tool - https://www.ngiq.asn.au/download/inspace-sprinkler-selection-tool/
	Technical article - https://www.ngiq.asn.au/download/drip-irrigation-design-management-2019/	Technical article - https://www.ngiq.asn.au/download/selecting-nursery-sprinklers/
	Video - https://www.youtube.com/watch?v=qQbLEWvwqjo&feature=youtu.be	Video - https://www.ngiq.asn.au/download/selecting-sprinklers-for-nursery-production/

System	Upright overhead sprinklers	Boom irrigation
Principle of operation	Water is forced through a nozzle. A spinner or water pressure then carries the water away from the sprinkler. Sprinklers are in an upright position.	A series of jets are located along a automated moving overhead boom with multiple droplet and pattern options available.
Advantages	Moderate installation cost. Wide range of emitters available. Lower maintenance. Can be used for frost mitigation.	Able to apply multiple small amounts of water in precise locations with customised programs. Can achieve very good uniformities. Can also be used to apply fertilisers and pesticides. Automated and labour saving. Saves water due to precise application.
Disadvantages	Affected by wind. Small changes in operating parameters can make a large difference to uniformity. Interference with nursery operations. Wet foliage may be more susceptible to disease. Less water efficient than drip and bottom watering systems.	Cost. Long runs required to reduce capital costs and maximise efficiency. Not suited to irregularly shaped growing areas. Mechanical components can break down. Worker safety for automated operation. May not be suitable for frost control.
Components	Water delivery system. Sprinklers and risers.	Water delivery system. Boom irrigator. Supporting structure or rail system. Drive system. Proportional fertiliser and chemical injector. Programable control system.
Design considerations	Design of sprinkler suited to upright operation. Diameter or radius of throw (radial leg). Operating pressure required. Spacing of sprinklers. Height of sprinklers. Other infrastructure - posts, benches, pathways, roof height in shadehouses.	Length of run. Speed of operation. Variation in application rates required. One way or two way operation. Operating pressure required. Jet sizes. Set up for different applications - irrigation, fertigation and pesticides.
Management	More affected by wind. May interfere with nursery work due to water spraying over the whole area.	Most commonly used with small containers but can be specified to suit most crop types with applicable flow rates. Multiple passes with low application rates. Close monitoring of water requirements is necessary with small containers.
Assessments	Upright sprinklers no longer used on this site.	Application rate 1.5 mm/pass. CU 87.1% SC 2.2. MAR 1.6 mm/pass. CU 89% SC 1.3 with edge results removed.
Grower comments	Easiest and cheapest to set up.	Best overhead system; can water what you want.
<u>Links to resources and publications -</u> https://nurseryproductionfms.com.au/download/water-management-best-practice-guidelines/	Sprinkler Selection Tool - https://www.ngiq.asn.au/download/inspace-sprinkler-selection-tool/	Sprinkler Assessment Tool - https://www.ngiq.asn.au/download/catch-can-test-data-collection-and-report/
	Technical article - https://www.ngiq.asn.au/download/selecting-nursery-sprinklers/	Supplier (information provided by Powerplants - http://eng.da-ros.com/ci3/
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