Drip Irrigation Design & Management

Nursery & Garden Industry Queensland

Drip irrigation has the potential to achieve significant water savings and improve plant quality, but to achieve these improvements the system must be designed and managed correctly. As with sprinkler irrigation, to achieve the best outcome the Best Management Practice benchmarks of Mean Application Rate (MAR), Coefficient of Uniformity (Cu) and Scheduling Coefficient (Sc) must be met when designing these systems .

Well designed and maintained drip irrigation systems can achieve Cu's of greater than 95 percent and Sc's less than 1.1, but the correct emitter needs to be selected to achieve these results. A pressure compensated, non-leak emitter (CNL) is a key component in any drip irrigation layout. These emitters reduce the variations in output through the system that are caused by pressure variations, but just as importantly, the non-leak function prevent laterals from draining when the system stops. The non-leak function allows the lateral to remain full of water when the system turns off, and consequently every emitter starts at the same time when the system next starts. This also means the line doesn't drain to the containers at the lowest point of the irrigated area. If non-CNL emitters are used on sloping sites, the application uniformity will be even worse, as the laterals will drain through the lowest emitter, and when the system next runs the lowest emitters will start first and operate for the longest time.

Flow rates from drip emitters are low compared with sprinklers, but the system must be designed to ensure that the rate water is applied doesn't exceed the ability of the growing media to absorb it. For example, if a two litre per hour dripper is used to irrigate a 200 mm pot, an MAR of 60 mm/hour results, which far exceeds the benchmark MAR of less than 15-20 mm/hour —See Table 1. If the MAR exceeds the absorption rate of the growing media the excess water cannot be absorbed, and the surplus water flows through the media and out of the container, leaching nutrients and increasing the amount of wastewater. The excess water applied also pushes the already applied water through the growing media, increasing leaching rates even further.

Table 1 – Application rates (mm/hour) resulting from the use of drippers on different size containers

Container size	Dripper rates in litres/hour			
	2	3	4	8
100 mm	250			
150 mm	110	170	230	
200 mm	60	95	130	250
250 mm	40	61	80	160
300 mm	30	42	60	110
330 mm	20	35	50	90
45 litre	20	27	40	70
75 litre	10	15	20	40

When the MAR is excessive, the amount of irrigation water required to wet the growing media increases, as not all of the applied waer is being absorbed by the growing media. This means the container isn't receiving sufficient water, and the reaction sometimes can be to increase run times. However, increasing run times will only make the leaching problem worse, as even more water is applied but still can't be absorbed by the growing media. If the media is not becoming wet, and significant amounts of water are draining from the container, a number of strategies can be used to increase water absorption:

- *the dripper flow rate can be reduced or,*
- *the flow rate from each dripper reduced by splitting the flow from each emitter across a number of pots using manifolds or,*
- *applications can be spread across multiple run times to match the application rate to the absorption rate of the growing media (pulsing) or,*
- *a combination of these strategies can be employed.*

Reducing dripper flow rates *to match the growing media absorption rate will maximise the lateral spread of water before it reaches the bottom of the container.*

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Many drip irrigation systems use emitters with flow rates of 2, 4, 8 or 12 litres per hour, which results in excessive application rates for most container sizes. Table 1 shows most drip irrigation systems apply water well above the best practice maximum of 15 –20 mm/hr.

***Reducing the flow rate from each dripper** can also be achieved by installing a multi-outlet manifold connected to 3 mm tubing, which are in turn secured to the growing media in the pot with a stake, known as an arrow. Care must be taken that the flow rate to each arrow is not less than 0.5 L/hour, as this will result in variability in the output from each arrow, reducing irrigation uniformity.*

To achieve uniform distribution of water through the growing media in larger containers, the water must be applied at more than one point on the top of the growing media. This can be achieved by either having multiple low flow rate drippers in each container, or having one manifolded dripper with multiple application points through arrows.

An example of a well set up drip irrigation system on a 400 mm pot would be a Netafim compensating non-leak (CNL) dripper discharging 3 litres per hour fitted with a 4 way manifold and 3 mm tubing to arrows delivering 0.75 litres per hour from each arrow, with 2 arrows per pot giving a MAR of 11.9 mm/hr — see Table 2.

Table 2 – MAR using 4-way manifolds and 3 litre/hour

Container size	Volume of pot (L)	Outlets/ pot	Drip rate L/hr	MAR mm/ hr
300 mm	15	1	0.75	10.6
330 mm	25	1	0.75	8.8
400 mm	35	2	1.5	11.9
45 L	45	2	1.5	11.9
500 mm	75	4	3	15.3
100 L	100	4	3	15.3
150 L	150	4	3	10.6

An alternative for large containers is the use of Miniscape drip tube placed in a loop on the top of the growing media. This can be looped around and joined at a tee to connect into a standard 13 mm or 19 mm low density polythene lateral. The larger the container, the longer the dripline required and more drippers used. By selecting an appropriate number of drippers for the size of the container the MAR can be adjusted to match the absorption rate of the growing media—see Table 3.

Table 3. Application rates using Miniscape dripline

Container size L	Number of drippers	Drip rate L/ hr	MAR mm/hr
200	2	3.8	11.4
400	4	7.6	11.4
600	6	11.4	11.4
800	10	19	14.2
1000	10	19	11.4
1200	15	28.5	14.2
1400	15	28.5	12.2
1600	20	38	14.2
1800	20	38	12.7

***Pulsing** can be used as a way of increasing the absorption of applied water by the growing media and improving lateral spread. Pulsing is achieved by operating the system for a short time, then stopping the system to allow the applied water to be absorbed, before running the system again. Efficient pulsing requires the use of non-leakage drippers and irrigation controllers. Such systems close the dripper off at low pressure and prevent water draining from the lateral, allowing all drippers to open and close simultaneously.*

***Growing media** for drip systems require must have good capillary action, to allow water to spread the throughout the container. The media should have minimum shrinkage when drying out, and media containing hydrophobic (water repellent) components, e.g. bark, need to have a wetting agent or 10% to 15% coir fibre added.*

Careful planning of the design and management of drip irrigation systems will pay dividends by decreasing water use and improving plant quality, particularly in large containers and in areas where sprinkler layouts may be difficult to install.

For more information refer to 'Nursery Industry Water Management Best Management Practice Guidelines'.

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