NURSERY PAPERS
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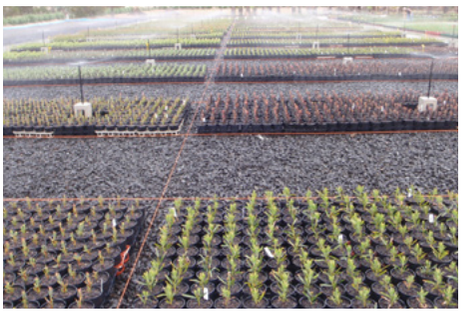
SPRINKLER SELECTION, LAYOUT AND OPERATION

INTRODUCTION

The process of applying irrigation water evenly across the cropping area is now a standard best management practice (BMP) aim. However, there is more to good irrigation than 'wet is good, dry is bad' rationale. Growers should consider the evenness of crop growth, crop health and crop turnover, and perhaps greater focus should be given to how irrigation systems are designed and how efficiently they are operating.

A well-designed overhead sprinkler system delivers water evenly across the growing area at an application rate that is compatible with the absorption rate of the growing media. With recent changes to growing media blends in Australia, renewed focus should be given to matching application rates to absorption rates. With the increasing use of **Coconut Fibre** (Coir) and similar products as growing media ingredients, adjustments to irrigation practice are required.

Sprinkler Irrigation



INDUSTRY IRRIGATION BMP PARAMETERS

The nursery industry has spent the past 25 years refining best management practices in irrigation. However, the basic pillars of efficient irrigation remain unchanged.

Coefficient of Uniformity (CU) is a measure of how evenly water is applied across an area and is indicated as a percentage. Industry Best Management Practise (BMP) guidelines state an aim of greater than 85%. This is best achieved by spacing sprinklers in a 'square grid pattern', at the distance apart specified in the sprinkler product performance table. Other factors including operating pressure and the height of the sprinkler riser from crop canopy will also affect results.

Scheduling Coefficient (SC) is a measure that compares the average wetted container against the driest section. It uses a multiplier to provide a value indicating how long you need to operate the irrigation to bring the driest container up to an acceptable level. Industry BMP suggests an aim of <1.5, however <1.3 is now a more realistic target. ***Note: Greenlife Industry Australia has evaluated grower SC data from some areas in Australia giving an average of 4.5, this means that those growers are potentially irrigating 4.5 times longer than they need to!***

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Mean Application Rate (MAR) is a measure of the rate irrigation water is applied in mm/hr. The key element is knowing the absorption rate of the growing media. The growth in use of coir as a media ingredient in recent years has increased the capacity of various media blends to absorb irrigation water. Pine bark based growing media has absorption rates in the range of 10-15mm/hr, however adding various rates of coir products can move this up to as high as 25mm/hr. Applying water at a rate that optimises growth, does not unnecessarily leach fertiliser, and results in faster growth and better plant health. The table below indicates some typical media blends and the approximate absorption rate guideline.

TABLE 1. Approximate growing media blends absorption rates

Growing media ingredients	Irrigation water absorption rate
Composted Bark (100%)	10 – 15mm/hr
Composted Bark 85% & Sand 15%	10 – 15mm/hr
Composted Bark (100%) + Wetting agent	15 – 20mm/hr
Composted Bark 85% & Sand 15% + Wetting agent	15 – 20mm/hr
Composted Bark 85% & Coir 15%	20 – 25mm/hr
Composted Bark 75% & Sand 15% + Coir 10%	20 – 25mm/hr
Composted Bark 50% & Coir 50%	20 – 25mm/hr
Coir 100%	20 – 25mm/hr

Sprinkler layout – a square grid design

Designing growing areas in conjunction with irrigation system performance criteria is sound business practice. It is best practice to design new bed widths to a standard, say 20m width, meaning you can utilise a 5x5m or even 4x4m irrigation grid design.

The grid design is based on the principle that every **plant container** receives irrigation water from **4 sprinklers.** We start our first line of sprinklers at the edge of a bed and replicate the grid design across to the other edge. Use of bespoke or proprietary road guards is also possible where required. The spacing should be based on the data from the sprinkler product performance table, with note of the applicable flow rate and pressure required to deliver the desired performance.

Pressure and Flow

A professional irrigation supplier should be able to confirm the fluid hydraulic requirements of the system. In short, will the sub-mains, laterals and risers deliver sufficient flow and pressure to the irrigation station to allow the sprinklers to meet expectations?

The system should be installed to meet these parameters, but ongoing monitoring and maintenance is also paramount to ongoing system success.

Nelson R10 Turbo

Nelson R10 with road guard

Upright or Inverted?

Upright systems are the standard choice for outdoor growing areas. With no other structural components, the simplest method is the laying of laterals along or under the surface of the growing area and the only items visible are the uprights/risers and sprinklers.

Above ground laterals present an ongoing WH&S issue but are sometimes unavoidable, particularly in retrofit situations.

If an upright system is chosen in a protected cropping situation, making the risers work into a design can be problematic. They cannot be in walkways, and they should not be adjacent to protected cropping frames/posts for example. The use of inverted sprinklers is sometimes a more desirable method. This allows for the complete unobstructed use of the complete growing area below as the irrigation water falls from above, simulating rainfall. Inverted sprinklers are designed to throw the irrigation water in a flat trajectory, enabling the irrigation water to combine and form a homogenous rainfall effect.

Wind

There are a few key considerations for growers with respect to the effect of wind on sprinklers.

Droplet size – If a short throw sprinkler is chosen (e.g. 3x3m) with a smaller droplet size, this contributes positively to the rainfall effect. In low wind situations they perform outstandingly. However, in higher wind sites, the droplets get blown around considerably. Larger droplet options are chosen to fight wind, penetrate foliage or be thrown greater distances, though this may displace growing media.

Droplet distribution method – Some growers prefer a traditional sprinkler that throws a range of droplet sizes in all directions (spinner distribution style), commonly starting at 3x3m spacing. There are several choices that will perform very well over 5x5 and 6x6m spacings with larger droplets that fight wind with some success. However, for high wind sites, consideration should be given to stream rotator distribution sprinklers. Some use multiple streams, others opt for a single stream. These sprinklers may not look uniform to the eye, however testing over the past 15 years suggests they are often the best performers on windy sites.

Sprinkler Spacing – If the spacing of the chosen sprinkler is at the lower end of the scale, for example 3x3m, it is far easier to achieve the industry BMP performance criteria. There is less likelihood of uniformity being affected by wind and other factors. The further apart the sprinklers are spaced, the greater the chance wind and other factors such as inadequate line pressure will affect results.

System Pressure – If a sprinkler performance specification sheet says the chosen sprinkler needs 250KPA to throw an effective 5m radius, and the system delivers 180KPA, it will not meet BMP expectations. Likewise, if a grower applies 350KPA in that same section, atomisation of the droplets will occur, wind will move the droplets more easily and performance will not meet expectations.

Trajectory – Many inverted overhead sprinklers throw the droplets in a low trajectory pattern. This allows for the irrigation water to provide a rainfall effect. There are also low trajectory upright sprinklers. If growers choose to throw water up in the air above the crop in an upright sprinkler application, it is likely that the wind will have a negative effect. Growers should aim to have enough trajectory to obtain the effective combining of water from 4 sprinklers, while also being at the designated distance above the crop.

Crop Factor – penetrating foliage

Sprinklers must be able to penetrate the foliage of densely vegetative crops. This may require almost sideways (lateral) water penetration into the canopy from sprinklers that project water in a stream such as rotor models.

This crop factor needs consideration as it may require separation of those crop types to one area where the irrigation system can be adjusted to suit. Some of these difficult crops prefer the overhead rainfall effect and a slower application rate to allow water to travel down branches and the trunk to eventually reach the growing media and roots. Other plants will need a stream rotator style sprinkler to force irrigation sideways. The downside is occasional displacement of media. Other plants may simply require installation of drip irrigation to overcome the issue.

Practical examples

GENERAL OUTDOOR NURSERY CROPPING – For smaller growing areas (under 20 metre width) the most common BMP layouts are 3x3 and 4x4 metre square grids. In growing areas above 20 metres in width, spacings of 5x5 and 6x6 are more common.

Growers must also decide on distribution style. Growers typically opt for a spinner style distribution of droplets, throwing different sized droplets in all directions simultaneously. These sprinkler options deliver solid BMP performance often at the higher end of targeted range. It is however recommended that growers consider stream rotator style options for high wind outdoor sites.

RECOMMENDATION – 4x4m and 5x5m grids, try Nelson S10 with black plate (or green plate for high wind/low trajectory situations.) For 5x5 and 6x6m grids try Antelco Rotor Max green/red/purple nozzles, they have a heavier droplet. The stream rotator Nelson R10 Turbo is ideal in windy locations.

GENERAL PROTECTED CROPPING – The dominant BMP layout is an overhead system, short spaced, normally 3x3m, 4x4m or 5x5m square grids. In most cases. Growers use some of the structural elements of the building such as cables and galvanised piping to hold laterals. This allows complete unencumbered use of the growing area below. Pathways, walkways, and individual growing beds can be set at enterprise specific spacings. Also, with sufficient height from sprinklers to crop canopy height, the irrigation water falls like a moderate shower of rain and has excellent CU, SC, and MAR results.

These installations typically use a 'dropper' with a weight that aims to allow the sprinkler to be horizontal to the ground, promoting peak performance. Many also have drip prevention devices as standard. Consideration should be given to ensuring that the dropper length does not reduce the distance to crop canopy height outside the optimum range, whilst also ensuring the sprinkler trajectory does not intercept shade-cloth, hail-net or other structural elements.

RECOMMENDATION – 3x3m, 4x4m and 5x5m grids, try either Netafim Spinnet with red nozzle and grey rotor (3m grid) or green rotor (4m grid) or Nelson S10 inverted with a grey (zero degrees trajectory plate) for 5m grids.

NARROW AREAS SUCH AS IGLOO-TYPE STRUCTURES – One of the more difficult scenarios in the industry is irrigation of long narrow structures like igloos. A common error is to treat them like irrigating a flower farm, where the water is intended for the soil/earth. Common dysfunctional systems have a single row of grossly overlapped sprinklers that generally overwater the crop. In production nursery situations, using the square grid pattern established to deliver BMP outcomes, growers simply divide the igloo (or similar) using the same method as mentioned previously.

If the igloo is 6 metres wide for example, simply run one row on each edge plus another lateral through the centre. This provides a 3m grid measurement in one direction. Then divide the house in the other direction to achieve as close as practical to 3 metres. Remember to consider height to crop canopy as many igloo structures are sometimes low at the eaves. For an 8-metre igloo using the above rationale to create a 4 metre grid is suggested.

It is important to note that a row of sprinklers along the edge looks like you are wasting water, even with the installation of road guards or home-made deflector plates. In reality, much of this irrigation water returns via the reticulated system and is available for re-use. It is always considerably less than what is wasted when sprinklers are not installed in the BMP layout.

Igloo irrigation

Catch Can Test

The bottom line

The best way to make sprinkler selections is in consultation with nursery industry specific best management practice. The need for application uniformity in production nurseries is critical, particularly with smaller containers.

Not following nursery industry BMP may result in the installation of sprinklers in dense multiple overlap rows along a lateral. which often results in considerably high application rates. The net effect is massive leaching, wasted water, increased energy use, poorer growth, and disease potential.

It's important to test the system, both prior to broader installation and ongoing. Once the irrigation system block has been installed, including all laterals and risers/droppers, purchase at least 4 of the proposed sprinkler type (9 will result in a better wetted area to conduct a test). Conduct a catch can test in this sub-section to ensure the system will meet enterprise specific and industry BMP parameters. (*There is a 'how to' video available on the* ***www.nurseryproductionfms.com.au*** *website*).

Check the system pressure in the irrigation zone also meets the specification sheet for the sprinkler used. When the catch can test indicates achievement of all BMP parameters, purchase the remainder of the sprinklers needed to complete the zone. If it does not meet requirements, seek further expert feedback before proceeding. Periodic ongoing testing of irrigation performance is also recommended. Sprinklers do not last forever and a set and forget rationale may result in disappointment. Team members adjust solenoids and do not return them to original positions, sprinklers wear, and systems may slowly block up or change over time.

It is recommended that business owners consult with irrigation professionals to help with installation of systems that will deliver the desired flow rate and pressure to each irrigation zone. There are also specialist advisors in the industry who can provide specific advice regarding sprinkler selection, optimum spacing and other nursery industry specific information. Contact your state or national association for further information.

MORE INFORMATION, LINKS AND FURTHER RESOURCES

Past editions of nursery papers are available online on the Greenlife Industry Australia website:
https://www.greenlifeindustry.com.au/Section?Action=View&Section_id=46

www.nurseryproductionfms.com.au

- Managing Water in Plant Nurseries
- Nursery Industry Water Management – Best Practice Guidelines