Measuring and improving the performance of overhead irrigation for container-grown crops

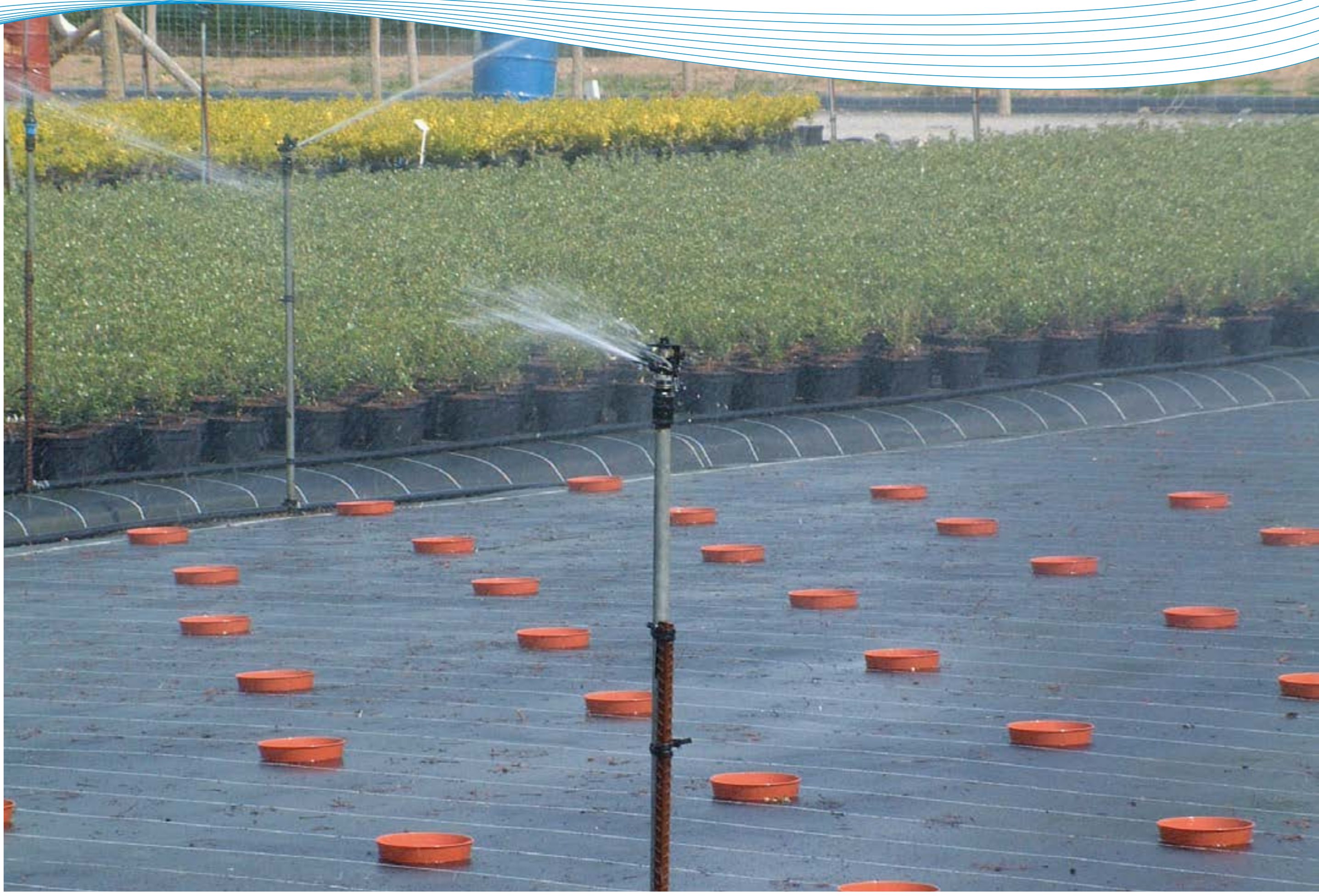


Figure 1. Knowing how much and how uniformly water is being applied to a crop is essential for good water management

This factsheet describes how water application rates and uniformity can be measured and improved for overhead irrigation systems for hardy nursery stock. It should be used in conjunction with the AHDB Horticulture Irrigation Calculator which enables irrigation distribution patterns to be viewed as a 3D graph. Examples of common distribution patterns achieved for overhead systems are provided together with recommendations on how these can be improved.

Action points

- **Regularly inspect and maintain the irrigation system to ensure that it's performing according to the manufacturer's recommendations**
- **As required, measure the volumes of water delivered over a set time by different nozzles or emitters used on the nursery, and ensure the output is uniform and appropriate via use of the AHDB Horticulture Irrigation Calculator located at horticulture.ahdb.org.uk/interactive-tools**
- **Install water meters so that the volumes of water applied over the season to different crops can be measured and recorded**
- **Try and group plants on the nursery by their irrigation need to make irrigation scheduling easier**
- **With any new production area, build in the infrastructure for water recapture, treatment, storage and reuse**

Introduction

Efficient irrigation of container-grown hardy nursery stock (HNS) crops presents specific challenges to growers not found with field-grown crops.

Whatever method of irrigation is used, it is essential to know how much and how uniformly water is being applied, as part of good crop and water management. This information is vital before improvements in irrigation efficiency or accurate scheduling can be attempted.

There are many reasons why growers should be focusing their attention to improve water management, but some of the main economic benefits for improving water application efficiency include:

- Reduced labour costs required for hand watering and picking up dry plants that have blown over
- Fewer plant losses from over- or under-watering
- Improved plant quality through better control of plant growth, weeds, diseases and nutrition

Other economic drivers include the 2014 Water Act, Water Framework Directive and abstraction reforms, which will require the demonstration of good water management. In particular restrictions on abstraction licences and the increasing costs of mains water means that existing supplies will have to be used more efficiently in order to sustain or expand production. The legislation is also aimed at restricting run-off and pollution leached from growing media which improvements in application efficiency should also help to achieve (Figure 1).

Calculating how much irrigation water is being applied to a crop

Irrigation and rainfall is almost always expressed as a depth of water (ie mm). The total volume of water applied to a crop will, of course, depend on the area concerned.

For example:

> **1mm water = 1 litre of water per square metre or 10,000 litres (ie 10m^3) per hectare**

Measuring the water volume used

It is useful to keep a regular record of the total water volume used for all or part of the nursery. This can be done by using a water meter, which allows the mean irrigation in mm to be calculated conveniently, provided the irrigated area is known.

Meter readings

Incorrect reading of meters can be a source of confusion, so some care is needed. Mechanical meters either have a digital display like a mileometer, or dials like old gas meters, or a combination of the two. Metric meters frequently have black digits reading to m^3, with red digits or dials reading decimal fractions of m^3 down to the nearest litre or 1/10 litre (Figure 2).

Checking readings

It can be helpful to fill a container of known volume such as a 10-litre bucket or 100-litre tank through a meter if there is doubt about the readings. Remember that older water meters may read in gallons, in which case readings

Figure 2. Using meters to record total water volumes used for all or part of the nursery is a useful tool for effective water management. This water meter is reading 72.8159m^3 or 72,815 litres

will need to be multiplied by 4.55 to convert them into litres. Finally, to ensure accurate readings, ensure the meter is being used within its specified flow rate range as stated in the manufacturers' catalogue.

Estimating the irrigated area

With overhead irrigation of container-grown HNS, using the actual cropped area to estimate the irrigated area gives a poor result as water throw beyond the bed edges is necessary to achieve satisfactory uniformity within the crop. The total wetted area is also a poor measure of the irrigated area as the rate of applied water typically tails off significantly at the edges.

A good method for defining a nominal irrigated area with conventional sprinkler layouts is to simply multiply the sprinkler spacing by the number of sprinklers. For example in Figure 3, a 32m x 3m bed is irrigated by two lines of 11 sprinklers running down the edges of the bed at a 3m x 3m spacing. In this case the irrigated area would be 198m^2 (2 x 11 x 3m x 3m), whereas the bed area would be 96m^2.

Calculating the water volume applied to the crop

Applying the standard recommendation of 8mm of irrigation to the crop described would therefore consume 8 litres/m^2 x 198m^2 = 1584 litres of water.

In a well-designed system, the actual irrigation received should be reasonably close to 8mm over the entire bed area where the sprinkler patterns overlap properly, but tails off outside this zone.

Clearly, if surplus water is not being recaptured, the greatest efficiency will be achieved by minimising the proportion of non-cropped area with an array of adjacent beds under a large sprinkler layout. The calculated irrigated area would be adjusted proportionately if

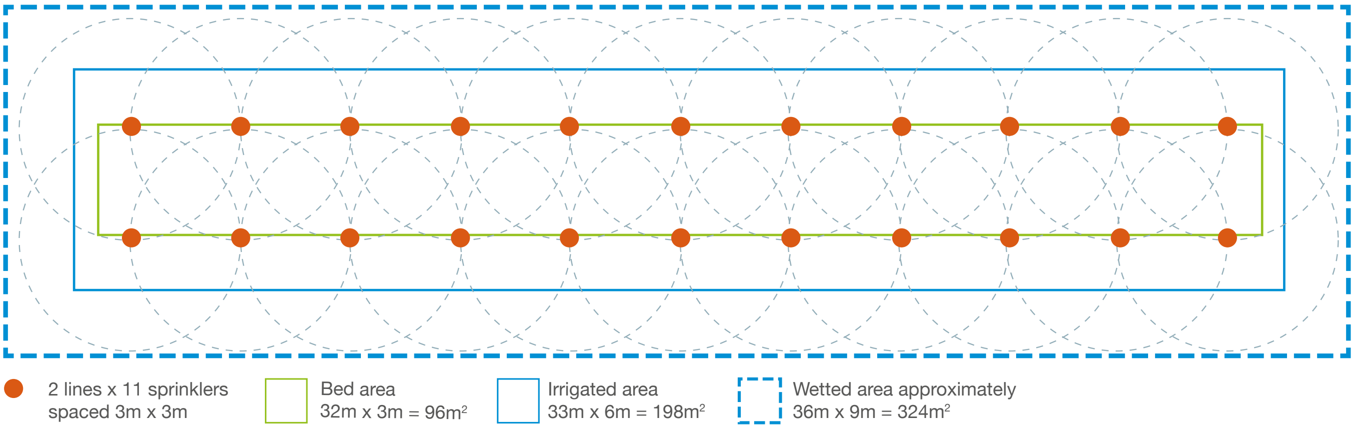


Figure 3. A good method for defining the irrigated area is to multiply the sprinkler spacing by the number of sprinklers

part-circle sprinklers were used, eg by half for 180° nozzles used along the sides of glasshouses or polythene tunnels.

It is always helpful to state how the irrigated area has been calculated in order to make meaningful comparisons between irrigation data for different sites and systems. With row crops in the field irrigated with lines of trickle tape, it is usual to include the alleyways but not headlands in the 'irrigated area', even though water is concentrated in a band down the rows or beds.

With drip-irrigated containers, capillary matting or sand beds, it is normal to equate the irrigated area to the actual bed area. Clearly, because little water is wasted between the containers, fewer mm of irrigation are required to wet up containers in these systems than with overhead sprinklers.

It should be noted that using saucers to measure overhead irrigation only measures the distribution pattern from the sprinklers not what actually gets into, or drains from, the container. The foliage canopy can have a significant effect, and some water that falls between containers can be taken up through the container base unless they are on a free draining bed based on gravel for example.

Measuring container weight gain is a useful method to assess net uptake where 1g weight gain will be equivalent to 1ml of water absorbed by the plant.

Measuring water application rate and uniformity of distribution

A well designed overhead sprinkler system will apply water evenly to all containers at an application rate that does not exceed the absorption rate of the growing media.

To carry out a practical measurement of application rate and uniformity of overhead irrigation systems, a simple and straightforward procedure is used. This will yield invaluable information about how well the system is operating but it will also help identify the key areas where improvements should be made.

The measurement procedure is as follows:

1. Select a representative area of either empty or cleared cropping bed to carry out the test. This area should extend right across the cropped width of bed to include both sides and by a length of bed covering at least one full space between sprinklers (Figure 4).

Figure 4. The use of equidistantly spaced saucers over a representative bed area for measuring irrigation output and distribution

2. Decide whether irrigation lines on adjacent beds should be run at the same time during the test. If there is much sprinkler overlap from adjacent beds, and these are normally run on a similar schedule to the bed being tested, these lines should also be run for the same duration.
3. Run the irrigation system briefly and observe the water output. Make sure that there are no obviously malfunctioning nozzles, and that the pressure is correct to obtain a typical distribution pattern. Normally the system should be checked on a reasonably calm day, but it can be illuminating to also compare output with measurements made on a breezy day to show how susceptible the distribution from the setup is to wind.
4. Space the saucers evenly over the area. It makes it easier to graphically display the results if they are spaced the same distance apart across and down the bed. Make a note of the saucer spacing. Make sure the spacings between the saucers are measured from the centre of the next, not the distance between saucer edges.

   The more saucers which can be placed down the better, but use at least 25-30 saucers with at least five each way. Saucers should all be of identical diameter, over 100mm. Record the diameter to the nearest mm. Saucers 20mm deep or more are fine. Make sure the saucers are level and if it is windy, use a stone in each to keep them in place. Ensure some saucers are located at the margins of the layout (eg edge of bed, dry corners) as well as the wettest spots (eg where distribution between individual sprinklers may overlap).
5. Run the irrigation for a sufficient period to collect an easily measured amount of water in the saucers eg 5–15mm of irrigation. Note the start and stop time. Avoid running sprinklers for too long so that saucers overflow or get too full to handle without spillage.
6. Measure the volume of water collected in each saucer. An appropriate sized measuring cylinder and funnel can be used (Figure 4), or electronic weighing scales tared to the weight of an empty saucer is a convenient alternative.
7. Record these in a logical order related to the layout or on a sketch plan so the data can be used to create a 3D representation of the distribution (using the AHDB Horticulture Irrigation Calculator).
8. Keep a record of the date, bed number, sprinkler type, position etc and relevant notes on the wind strength and direction, pressure settings, location of hedges/pathways etc that may influence the results.

Using the AHDB Horticulture Irrigation Calculator

In order to make full use of the data recorded in the above procedure, it is recommended that it is entered into the simple 'calculator' available on the AHDB Horticulture website at horticulture.ahdb.org.uk/interactive-tools. The calculator converts the saucer data recorded into a 3D chart, which shows the distribution pattern of the water applied over the bed (Figure 5).

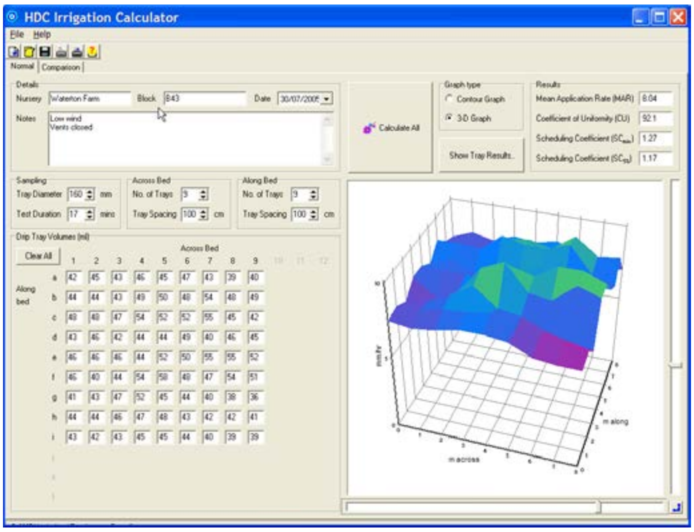


Figure 5. Example output from the AHDB Horticulture Irrigation Calculator showing the data entry page and 3D distribution graph

To do this, the volumes caught need to be entered together with the diameter of the saucers and the run time for the test. The software is simple to use and the exercise is invaluable in highlighting where improvements should be made as the following practical examples demonstrate.

Data can be saved, and side-by-side comparisons made of two data sets if required.

Industry standards for application rates and uniformity of irrigation

The AHDB Horticulture Irrigation Calculator also calculates values for the three irrigation system standards which summarise application rates and uniformity of irrigation systems.

For overhead irrigation, all three can be calculated by using the data collected in the method described previously (ie measuring water collected in saucers distributed over a representative area of production bed).

Calculating these values will further highlight where improvements need to be made in the system in order to optimise performance. See examples 1 to 5 for further information.

The three standards are defined as follows:

1. **Mean application rate (MAR)**
   This is the average irrigation rate over the whole area sampled.
2. **Christiansen's coefficient of uniformity (CU)**
   This is the overall uniformity of water distribution for the sampled area.
3. **Scheduling coefficient (SC)**
   This is the ratio of the average irrigation rate to the lowest irrigation rate measured. This represents how much the irrigation time must be multiplied by to ensure the driest areas receive the intended (ie mean) irrigation quantity.

The Nursery Industry Association of Australia (NIAA) has recommended the following performance guidelines for nursery systems based on the mean application rate, coefficient of uniformity and scheduling coefficient.

Specifically these are:

- **MAR should be less than 15mm/hr**
  Few growing media mixes can absorb water faster than this without excessive run-through. In practice, lower MAR's may be used (eg 4-10mm/hr) particularly for smaller containers and plug trays

$$\text{MAR} = \frac{\text{sum of catch rate from all saucers}}{\text{number of saucers}}$$

- **CU should be more than 85%**
  100% represents perfect uniformity. In practice, even overhead sprinklers can be designed to achieve 95% under ideal (calm) weather conditions

$$\text{CU} = 1 - \left[\frac{\text{(mean difference from mean catch)}}{\text{mean catch}}\right] \times 100$$

- **SC should be less than 1.5**
  A high SC represents uneven watering leading to excessive water use and fertiliser leaching or the need for much spot watering by hand. A survey of 180 Australian nurseries revealed that only 13% achieved this target, and more than 30% of systems had SC values greater than 3

$$\text{SC} = \frac{\text{mean catch rate or MAR}}{\text{lowest catch rate sampled}}$$

Interpreting the results generated

Example 1

Good distribution but poor application rate

Figure 6 shows a distribution graph extract from the AHDB Horticulture Irrigation Calculator achieved using Rotoframe sprinklers. They are being used to irrigate beds of herbaceous perennials. Overlap from sprinklers on adjacent beds is necessary to achieve an even distribution, but this is acceptable on this nursery where the outdoor crops require broadly similar irrigation regimes.

Rotoframe sprinklers are sometimes criticised for uneven watering, but here the 5.0m x 5.0m overall spacing has given good uniformity (under calm conditions) with a CU of 92% and SC of 1.15 However, the mean application rate of 25.4mm/hr is higher than the guideline recommendation, as it cannot readily be reduced with this nozzle type, being that it comes with only one jet size.

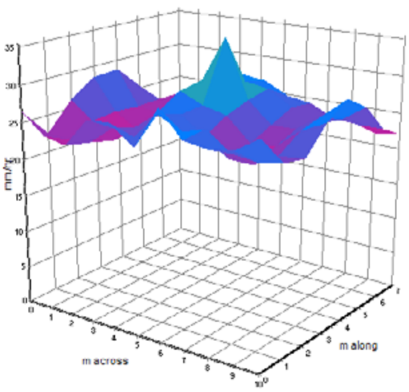


Figure 6. Example of good distribution using Rotoframe sprinklers that could be improved by pulsing the irrigation to reduce the MAR

Recommendation

The effective application rate can be reduced by 'pulsing' the irrigation eg a 15 minute dose could be applied in three five-minute bursts with at least 20 minutes between each to allow absorption of the water by the growing medium.

Example 2

Poor distribution

Dan Super Mamkad sprinklers give a gentle application rate of about 6mm/hr and well within the guideline recommendation. However, the sprinkler configuration gives poor water distribution (CU 71.5%, SC 1.71) resulting in peaks down the centre of the bed with relatively little irrigation water reaching the bed edges (Figure 7).

Sprinklers are spaced 8.0m apart down the bed, but lines are 6.6m apart on the bed with a gap of 12.0m across the wide roadway before the next line on the adjacent bed. Although this means that relatively little water falls on the roadway, the poor uniformity probably results in more wastage in practice (see the more detailed example in Figure 12).

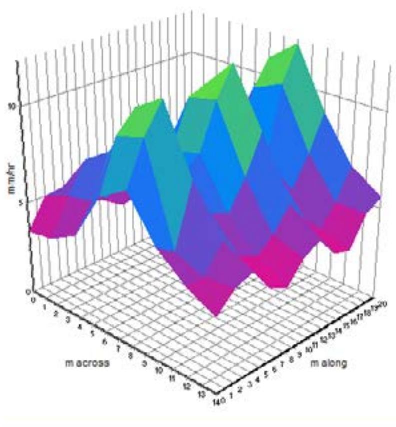


Figure 7. Example of poor distribution that could be improved by making the irrigation lines equidistant both across and down the bed

> *Recommendation*
> It would be better to have lines equidistant across the site (9.5m apart). Even though this may compromise giving different irrigation regimes to adjacent beds because of overlap, uniform plant moisture status within the crop should be much easier to manage with less waste than from the current arrangement.

Example 3

Good distribution

Figure 8 shows an example of good distribution that has been achieved on a calm day using Eindor 861 black nozzles, at a spacing of 3.45m x 2.0m, used to irrigate small trial beds. The mean application rate, scheduling and uniformity values are all well within the recommended industry standards.

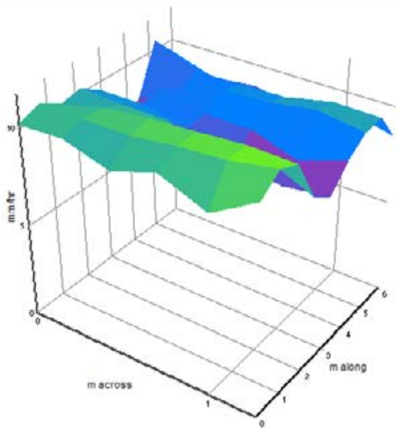


Figure 8. Example of good distribution from three lines of Eindor 861 sprinklers over experimental beds at HRI Efford

> *Recommendation*
> No further action required in this instance.

Example 4

Poor distribution along the edges of the bed

Rainbird 2045PJ plastic impact sprinklers are used along the bed edges and set to 180° part-circle operation so that each bed can be irrigated independently. Sprinklers are spaced 7.1m across the bed width and 8.0m down the bed. Irrigation is reasonably uniform (CU 87%, SC 1.46), but there is some fall off along the bed edges (Figure 9).

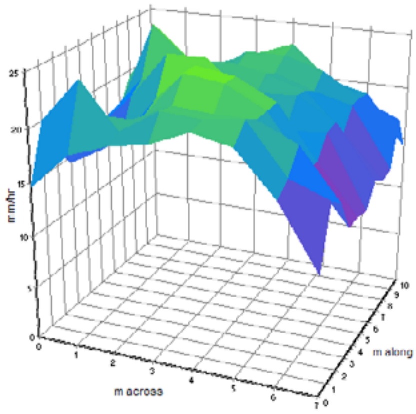


Figure 9. Example of poor distribution along the bed edges. Impact sprinklers set to 220° and the use of smaller nozzles will help improve the distribution and output

Recommendation

Impact sprinklers along the bed edges should be used and set to a 220° arc to improve the wetting of containers down the side, particularly if there is a slight breeze. The 20mm/hr MAR could be reduced in this case by the substitution of a smaller nozzle. The distribution pattern from impact sprinklers can also be influenced by adjustment of the diffuser pin, which breaks up the water stream, the baffle deflector and the jet trajectory angle. Manufacturer's notes should be consulted for details. This production area is also collecting, treating and re-using runoff water from beds (Figure 10 and 10a). This should be seriously considered by all new installations using overhead irrigation as a major contribution towards water use efficiency on the nursery.

Figure 10. Water collection from production beds

Figure 10a. Recycling of run-off from production beds

Example 5

Effect of wind on the distribution pattern

Figure 11 shows how wind (from the right) is causing water from the part-circle sprinkler to drift onto the adjacent roadway and bed.

Figure 11. Wind can significantly affect the distribution pattern from sprinkler irrigation - check wind breaks, riser heights and water trajectories

Recommendation

As a general rule, try to irrigate when weather conditions are calm. If the site is predominantly windy, put up wind breaks, around and/or within the production site, ensure the risers match the height of the crop and the water trajectory from the sprinklers is not too high.

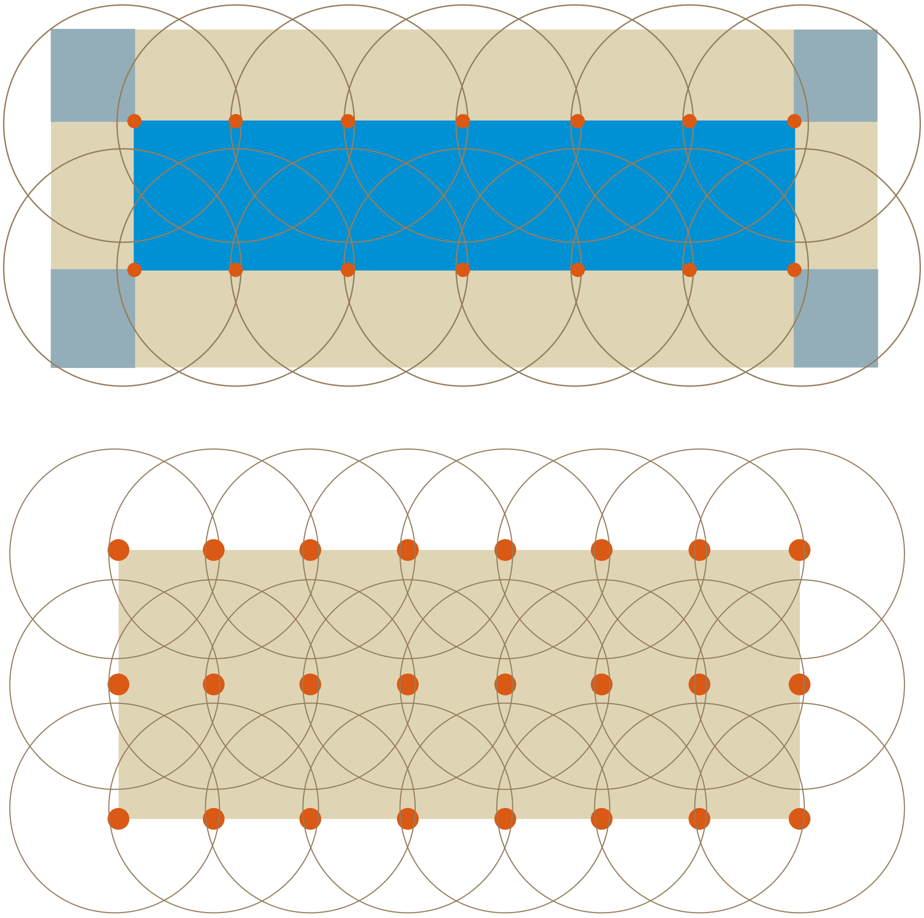
Main factors affecting application uniformity and consumption

What is the effect of sprinkler layout?

Using fewer sprinklers than needed to get uniform water distribution can be a false economy. For example, System A in Figure 12 uses 14 sprinklers, which do not overlap sufficiently. The system has a SC of 2.4 (it should be less than 1.5) and a MAR of 8.0mm/hr (it should be less than 15.0mm/hr).

This is compared to System B which uses 24 sprinklers that overlap correctly, has a much better SC of 1.2 and a MAR of 10.0mm/hr.

This means that the running time and hence, volume of water, needed to deliver 6mm of water to the containers along the edges and corners of the beds will be greater for System A (fewer sprinklers) than System B, as shown in the calculation.



System A: MAR = 8.0mm/hr and SC = 2.4

System B: MAR = 10.0mm/hr and SC = 1.2

Figure 12. Incomplete sprinkler overlap in System A results in drier bed edges and corners compared to System B

The running time of each system can be calculated as follows:

$$\text{System A: } \frac{6.0\text{mm}}{\text{MAR } 8.0\text{mm/h}} \times 60 \text{ mins} \times \text{SC } 2.4 = 108 \text{ mins}$$

$$\text{System B: } \frac{6.0\text{mm}}{\text{MAR } 10.0\text{mm/h}} \times 60 \text{ mins} \times \text{SC } 1.2 = 43 \text{ mins}$$

Assuming both systems were using nozzles with a 40 litre/hour discharge, the water consumption for each system for a 6mm dose would be:

$$\text{System A: } \frac{108 \text{ mins} \times 14 \text{ sprinklers} \times 40\text{L/h}}{60 \text{ mins}} = 1008 \text{ litres}$$

$$\text{System B: } \frac{43 \text{ mins} \times 24 \text{ sprinklers} \times 40\text{L/h}}{60 \text{ mins}} = 688 \text{ litres}$$

Using System B, which has 10 more sprinklers over the same area as System A, means over 30% less water is used despite spreading some water beyond the bed edges.

This overspill area actually means distribution over the bed will be less affected by wind drift. Recapturing and recycling of surplus water will result in further savings.

As a general rule of thumb, plants should receive water from four overlapping sprinklers to achieve a low SC and reduce dry spots, over-watering and excessive leaching. The first and last row of sprinklers should be located along the edges of the production area.

What is the effect of water pressure?

Spray pattern can be affected if sprinklers are not run within the range of pressures for which they are designed. Low pressures due to blocked filters or an overloaded system can reduce spread and lead to rotating parts getting stuck. Excessive pressures can reduce droplet size and increase drift. Pressure compensated nozzles and regulators will help but only where a minimum supply pressure can be maintained.

What is the effect of nozzle type?

Generally full circle sprinklers, give a more uniform distribution than part circle sprinklers, particularly with the mini-sprinkler type nozzles. If wetting of paths or adjacent beds has to be prevented, then fit baffles – this will deflect a little more water onto the first couple of rows along bed edges. Where part-circle sprinklers are sometimes used eg along margins of polythene tunnels or glasshouses, then 220° rather than 180° sprinklers may perform better (Figure 13).

What is the effect of wind drift?

Wind drift can have a dramatic effect on the distribution pattern achieved from overhead systems. Effective use should be made of windbreaks or shelter with overhead systems to minimise wind drift. Nozzle heights should be selected to suit the crop wherever possible, and water trajectories should remain well below shelter

Figure 13. Setting part-circle impact sprinkles to a 220° arc down the sides of beds will usually improve wetting of edge containers compared to a 180° arc

height. Much taller windbreaks are required if a significant growing-on area is being protected, as shelter is only effective over a leeward distance equal to about six times the height of the windbreak above the sprinkler jet stream.

Other considerations

- Group plants together to minimise watering uncropped areas. In partially filled beds, consider fitting blanking plugs to switch off unused nozzles at the end of a line
- Reduce spacing between containers and the area devoted to pathways to minimise water wastage
- Pot on plants into larger containers earlier rather than later. Losses between containers is reduced, and the increased reservoir of stored water allows for longer periods between irrigations
- Improve water absorption and retention in growing media and reduce run-through by using a wetting agent if the mix is water repellent when dry
- Reduce evaporation losses from growing media by using a loose fill mulch such as bark or cocoshell
- Effective irrigation scheduling – applying the correct amount only when necessary – will significantly improve efficiency, reduce run-through and leaching, and improve plant quality. See AHDB Horticulture Factsheet 18/17 for further details
- Do not ignore hand watering when necessary. This may be the only practical way of dealing with some areas that dry out faster such as exposed bed ends or edges. However, good hand watering is a skilled job and it should be part of a planned irrigation strategy

Designing efficient irrigation systems

The irrigation system is an integral part of the whole production process. A good understanding of the plant's water requirements, even application and management constraints should be the first step to good system design, prior to detailed considerations of pipes and plumbing, pumps, nozzle types etc.

Grouping plant types according to irrigation need

Full consideration of the system planning, design and installation process is beyond the scope of this factsheet, but it should start by splitting the nursery into areas with similar watering and management needs such as propagation areas, polythene tunnels and glasshouses, soil-grown stock plants or other crops, benched areas and so on. Within these categories, there may be subdivisions according to size of container or subjects that will require different irrigation schedules (Figure 14). These areas will largely determine the most appropriate choice of irrigation method, whether it be overhead sprinklers, mobile booms, drippers, trickle or the various sub-irrigation options for containers. Correct planning at this stage and choosing enough block divisions for flexibility of watering is essential to enable schedules and crop requirements to be matched efficiently.

Using more closely spaced sprinklers with smaller wetted diameters gives greater flexibility when designing layouts, because they can be divided into smaller blocks. It is important that plants receive water from four overlapping sprinklers to achieve a low SC and reduce dry spots, over-watering and excessive leaching. The first and last row of sprinklers should be located along the edges of the production area. Enough lines must be turned on when irrigating sub-blocks of a multi-bed production area to ensure full sprinkler overlap on the target beds to irrigate uniformly. Unless sprinkler lines coincide with bed edges, this may involve running an extra line on adjacent beds.

Application uniformity and scheduling

Good uniformity of application is an essential precondition for scheduling irrigation and minimising water wastage. No matter how sophisticated the method used to schedule irrigation, results will always be compromised if water is being applied unevenly as some plants will inevitably be receiving too little or too much. See AHDB Horticulture Factsheet 18/17 for further details on scheduling irrigation.

Water recapture and treatment

Any new production area should seriously consider providing the infrastructure for water recapture, treatment, storage and reuse. Improvements in this area will be greatest for overhead irrigation systems, but it is relevant to all systems where containment of nursery runoff to minimise pollution risk is needed. The changing economics of water management may mean that it becomes worthwhile to retrofit or upgrade existing layouts to enable irrigation recapture and rainwater harvesting.

Seek advice from the specialists

Once the irrigation requirements for each area of the nursery are known, it is then best to consult a specialist

Figure 14. Grouping plants together according to their irrigation needs and management requirements is an essential step in planning and designing a new irrigation system

irrigation designer for the most appropriate choice and layout of application hardware, pipe sizes, pumps, control valves, filters, and so on, particularly for complex nursery layouts.

They will probably make use of design software, which allows different combinations of pipe spacing's, sprinkler configurations, riser heights, nozzle types and ratings, water pressure etc to be tested 'on screen'. It will enable the most appropriate design(s) for your area that fit your requirements for output and uniformity to be chosen. Much of this software is linked to a particular manufacturer's range of equipment, but may be available free of charge from them. For uncomplicated layouts the software enables growers to test options themselves.

Before an irrigation installation is accepted, growers should check it meets the requirements specified and agreed with the irrigation designer and supplier. This should include setting correct operating pressures for each area and measuring actual MAR, CU and SC as described previously.

Management and maintenance considerations

As with other equipment on the nursery, a maintenance plan should be drawn up and followed to make sure irrigation kit continues to perform to design standards. Some common things to check are listed below.

Discharge rates and uniformity

Discharge rates of sprinklers, drip lines, trickle tape etc, should be made annually using a water meter. Measure the output from a known number of sprinklers over a set period of time so that the water used in litres/number of sprinklers/number of minutes will equal the mean litres per nozzle, per minute. Blocked or faulty components should be fixed. At the same time, check the system on the cropped area for MAR and uniformity of distribution as described previously and make repairs/adjustments as necessary.

Filters, pressure regulators, valves and pumps are also key components, which should feature in the annual maintenance plan.

Water pressure

This should be regularly checked with either permanent or 'plug in' pressure gauges at strategic points in the system, and the cause of any problems identified and rectified. Poor water pressure may simply be a symptom of system overload, with too many areas being irrigated at the same time. Cycling irrigation between stations, 'pulsing' applications or using lower output systems for a longer period may be a more appropriate alternative to increasing pump outputs or if the primary supply (eg mains water) is limiting.

Adapting the measuring procedure for other irrigation systems

Mist and sub-irrigation systems

The saucer procedure can also be used, as described, to check distribution uniformity under mist propagation areas. With sub-irrigation systems such as capillary matting, sand beds, and ebb and flow benches, the weight gain of containers due to irrigation can be measured and this data used in the same way as saucer volumes. 1g weight gain will be equivalent to 1ml of water absorbed by the plant and the data can be entered into the AHDB Horticulture Irrigation Calculator as 'tray volumes'. In this case, the diameter of the plant container should be entered into the 'diameter of catch container' cell to arrive at an MAR equivalent to an overhead irrigation application assuming that all the water applied over the container surface area entered the container. A representative set of containers need to be tagged and weights recorded before and after irrigation, allowing for sufficient time for plants to absorb water (or surplus to drain in the case of ebb and flow benches). Poor distribution with capillary irrigation fed by trickle or drip lines, can sometimes be rectified by reducing the spacing between lines.

There is however cautionary advice with this method. The amount of additional water taken up by a plant will partly depend on the moisture content of the growing medium to start with. Results can be misleading if there is a large variation between plants before irrigation. Those near to pot capacity will absorb less additional water than drier plants. Following lifting and weighing containers, check the standing base is reasonably moist and containers are pushed back firmly to re-establish capillary contact between sand or matting and the growing medium in the container.

Drip irrigation systems

With drip irrigation (Figure 15), if the output and uniformity of the distribution system itself is being measured, then dripper outlets should be placed into saucers. However, the net gain in water retained by the growing medium after any run-through or surplus has drained, can be measured as pot weight gain. Likewise with overhead irrigation, the saucer procedure measures the distribution pattern from the sprinklers, not what actually gets into, or drains from, the container. Again, measuring plant weight gain can be used to assess net uptake and uniformity compared to the system's application pattern.

Figure 15. Drip irrigation in the production of container-grown nursery stock

Further information

AHDB Horticulture factsheets and publications

Factsheet 18/17: 'Methods and equipment for matching irrigation supply to demand in container-grown crops'.

Factsheet 05/17: 'Precision scheduling of irrigation in the production of container-grown hardy nursery stock in various growing media'.

Factsheet 15/06: 'Water quality for irrigation of container ornamentals'.

Factsheet 01/06: 'Capillary irrigation of container-grown nursery stock'.

Factsheet 07/05: 'Securing your water supply for the future'.

AHDB Horticulture grower summaries and reports

HNS 182: 'Developing optimum irrigation guidelines for peat-reduced, peat-free and industry standard substrates'.

HNS 159: 'Nursery stock propagation: Nursery evaluation and demonstration of the Evaposensor towards its commercial availability as a mist controller'.

HNS 141: 'Improving the quality of HNS and roses using irrigation and fertigation management techniques'.

HNS 122: 'Container nursery stock irrigation: Demonstration and promotion of best practice'.

HNS 117: 'Identifying the key factors controlling HNS uniformity'.

HNS 107a: 'Improving water management within growing media'.

HNS 107: 'Container HNS irrigation: Use of capillary matting under protection'.

HNS 97b/Horticulture LINK project HL0168: 'Enhancing the quality of hardy nursery stock and sustainability of the industry through novel water saving techniques'.

HNS 97/Horticulture LINK project 201: 'Improving the control and efficiency of water use in container-grown hardy ornamental nursery stock'.

Other publications

Managing water in plant nurseries, a guide to irrigation, drainage and water recycling in containerised plant nurseries. NSW Agriculture.

AHDB Horticulture Irrigation Calculator

The Irrigation Calculator which accompanies this factsheet can be found on the AHDB Horticulture website at horticulture.ahdb.org.uk/interactive-tools.

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Acknowledgements

The work reported here has been undertaken within the AHDB Horticulture-funded project HNS 97 'Improving the control and efficiency of water use in container-grown hardy ornamental nursery stock' and project HNS 122 'Container nursery stock irrigation: Demonstration and promotion of best practice'. Thanks in particular go to Wyevale Nurseries Ltd, Johnson's of Whixley Ltd, and W Godfrey and Sons Ltd for use of their data. Thanks also to the science and nursery staff at the former HRI Efford. Finally, experience and information on nursery water management from the Nursery Industry Association of Australia is gratefully acknowledged.

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