

Water Management in Production Nurseries

Water availability has not been a major concern to the nursery industry until recently. Increased urban pressure, recent drought conditions, and climate change concerns have shifted the community and grower focus more to water availability, use, and sustainability.

Irrigation management is a complex decision making process that can be complicated by a lack of information on plant water use, ineffective and inefficient irrigation systems, and grower time constraints.

There are times when the amount of water available for production is simply not enough, and consideration needs to be given to how water supplies can be increased or used more effectively. A thoughtful approach to this issue is more likely to provide a satisfactory outcome, as making decisions based on assumptions, or poor information, can lead to costly mistakes.

*The first step in managing water is to **measure water use**. This allows informed management and costing decisions to be made based on facts, not assumptions, and allows cost savings to be quantified.*

Water meters installed in the irrigation system can quickly and simply provide water use data for a



growing season or production year. This information can include both crop irrigation use, along with other nursery water use such as washing and cleaning of beds, benches and containers.

Where a water meter is not installed it's possible to calculate water use by measuring the volume of water emitted by one sprinkler in an irrigation zone, multiplying by the number of sprinklers in that zone, and then multiplying this by the duration the irrigation zone is operated during a period. The results from each irrigation zone can then be totaled and added to the calculated water volume used in general hosing and cleaning in a similar time frame.

A knowledge of water use is important when considering the availability of different types of water supply. For example, town water supplies may be limited by restrictions on 'time of day' use, supply due to service pipe size, restriction on volumes available for general horticulture, and seasonal restrictions due to local conditions such as drought.

Rainfall and evaporation should also be recorded, as these have a major influence on water use, and this information is useful when comparing water use from year to year.

*Once the amount of water being used is known the next step is to determine how secure the water supply is. **A water balance** can be used to calculate how much water is available in a given month of the year in a range of differing rainfall years. Water available for production and irrigation can be calculated and compared against rainfall data from normal and dry years to identify any shortfalls that*

may occur.

Calculating a water balance can help identify areas where water savings can be made, and alternative strategies that can be employed to increase the amount of available water, and allow scenarios to be run, e.g. what if water is recycled.

It's also difficult to communicate with government or local authorities for water allocations or water access if production irrigation requirements for a business are not available. Financial institutions are more comfortable in lending money if business sustainability can be documented. Local authorities often require documentation on sustainability and catchment interaction when reviewing site approvals for development.

In a water balance for surface water storages, the monthly average rainfall, evaporation, seepage, water use and recycling need to be taken into account. A similar calculation can be made for bores and water allocations, but rainfall, evaporation, seepage and recycling don't need to be taken into account in these situations.

The information contained in an Irrigation Drainage and Energy Management Plan (IDEMP) helps to answer many or these questions, and provides a prioritised action plan to improve overall system efficiency.

Calculate future water requirements to enable sensible production planning and expansion plans.

Contingency planning for dry years and drought periods is not possible without an understanding of production water use requirements. Data on previous water use can be used to estimate the effect on water security if production areas are increased.

Current licensing requirements must be investigated before commencing any works on dams or water



extraction infrastructure. Contact the relevant regulatory authority to establish if the proposed works are allowed. These authorities may also have information on other options to increase water availability.

Water allocations and purchasing additional water may be an option to increase available water in areas with irrigation schemes.

Installing recycling systems can significantly increase available water. When using recycled water for nursery production, disinfestation of the water prior to use is required to reduce the risk from pathogens.

Reducing evaporation from storages using methods such as chemical layers, floating covers or fixed covers may be considered. Which methods are used will depend on the value placed on the water saved.

Most dams lose water through seepage, but if the losses are excessive dam liners can be used to eliminate this loss. Dam liners can also be considered if the soil structure is unsuitable for holding water when constructing new water storages.

The water balance, and the cost of evaporation and seepage mitigation options, can be useful in deciding if the cost of implementing mitigation measures have an acceptable payback period.

Growing media selection is vital to support an efficient irrigation system. Growing media should be selected to provide optimum air filled porosity, water holding capacity, and nutrient availability during plant growth and development .

Assessing the efficiency of irrigation layouts gives an appreciation of the effectiveness of each irrigation system in the nursery, how much water the system can apply, and how quickly and how accurately the water is applied.



Assessing the efficiency of irrigation layouts will show how the system performs against best management practice, but It also gives information on mean application rates and uniformity, which can be used to fine tune irrigation scheduling.

Install or upgrade irrigation layouts to Best Management Practice to improve efficiency and decrease water use. Improving irrigation layouts will also affect irrigation scheduling practices.

Scheduling irrigation is often described as ‘applying the right amount of water at the right time’ and is a crucial tool in good irrigation management.

Improved irrigation scheduling can increase crop production, conserve water, decrease fertiliser requirements, reduce wastewater runoff, decrease pest and disease incidence, and generally improve business profitability without significant financial outlay.

Excessive irrigation probably causes as many or more problems than any other irrigation issue. The

effects of over-irrigating are not always immediately obvious to the grower, and irrigation is often not recognised as the problem. Excessive irrigation is wasteful of water, energy, labour and resources. It leaches nutrients from the growing media, depriving the crop of its required level of fertiliser, and leaching these nutrients into the waste water, to eventually flow to water storages or the environment.

Excessive irrigation can also cause the growing media within each container to become saturated or waterlogged, denying the roots of their necessary air supply. The excess water applied during over-irrigation comes at a cost, not only to the crop, but also to a grower’s bottom line. Extra costs incurred may come from the purchase of excess water, as in a reticulated town supply or

Container crops have little natural ability to cope with environmental extremes and can be exceedingly vulnerable to atmospheric water loss. Of the water taken up by healthy plant roots, only ten percent is utilised in the actual process of plant growth, while up to ninety percent is lost to the atmosphere through transpiration, used by the plant for cooling and assisting in the mass flow of water from the roots to the upper parts of the plant. Supported by good moisture levels in the growing media, plants will quickly attempt to absorb water, replacing any water that is lost to the atmosphere. The goal of nursery irrigation is to ensure ideal moisture levels, along with optimum air concentration in the growing media in each container, allowing the plant to replenish its water needs, take up minerals and other organic compounds to supply the plant, and avoid stress. Keeping the variation in moisture levels in the container growing media to a minimum provides the opportunity for optimum water supply to the plant, maximising growth and production.

from a managed scheme, extra on-farm storage, energy to transfer and/or pump the water, costs to disinfect and management of the additional waste water.

Insufficient irrigation can stress the crop, reduce turnover rates, impede uniform production, encourage pest and disease, and adversely affect plant quality. Limiting the availability of water to nursery crops in containers may lead to loss of plant turgidity and wilting of the crop. However, plants usually recover quickly after irrigation. If crops are allowed to dry out excessively, plants will not recover after rehydration of the growing media. This point is often referred to as the permanent wilt point and is different for every plant species.

Local research trials in Australia comparing different scheduling methods showed water use reductions of up to 53% when applying water according to plant needs versus timed irrigation—refer to “Nursery & Garden Industry Australia – Final Report May 2008 Increasing Adoption of Irrigation and Water Recycling Technologies in Australian Nurseries.” for more information.

Nursery owners and managers have traditionally used their grower experience and judgement to decide on time schedules for irrigation. Times have habitually been altered only two or four times a year to match seasonal variations. However, reviewing irrigation scheduling more often can identify if current scheduling practices are adequate, and if changes need to be made. While more frequent changes to irrigation scheduling may seem onerous, the latest generation irrigation controllers have the ability to alter the irrigation scheduling across all

stations or zones by a percentage, allowing a more flexible approach to water management with minimum labour input.

Ideally, for the most efficient use of water, adjusting irrigation scheduling should be a daily task, as irrigation times need to be adjusted to match the daily water requirements of plants. This can be done by feel, but a more accurate way is to either relate the evaporation rate to plant water use, or weigh containers to establish how much water has been used. This allows the length of the irrigation time required to bring the containers back to full capacity to be calculated.



The timing of irrigation applications is often dictated by the irrigation pumping and distribution system, the on-farm application techniques, along with non-irrigation periods required, e.g. worker access to production areas for despatch activities.

Nurseries often struggle to manage their irrigation in the time available. Irrigation late in the afternoon or after dark can lead to crop foliage staying wet for extended periods increasing the risk of disease outbreaks. Irrigating during excessively strong winds, or times of high temperature and low humidity can increase water loss through evaporation. Reducing the number of start times may also assist in reducing water lost to evaporation from foliage.

Irrigation applications should be scheduled to provide some leaching from the containers to prevent crops being injured by salinity. A leaching fraction (LF) of approximately 12 percent is recommended, however poorly scheduled irrigation

can often result in considerably higher or lower leaching fractions.

Grouping plants according to water requirement allows scheduling to match plant daily water requirements more accurately. This may be difficult to achieve in practice, but can have a significant effect in reducing overall water use and improving plant quality.

Many factors can influence the frequency and the volume of water required in nursery container production, and these need to be considered when locating plants into production areas or irrigation zones. A production nursery can often have hundreds of different plant species and varieties, all at different stages of growth, which are all exposed to varying levels of rainfall, wind and light conditions. Plants also vary in their growth rate and therefore their water and nutrient requirements. Scheduling irrigation to a growing pad or zone is often dictated by the fastest growing plant species or variety, or the ones with the highest water requirements. Consequently, minimising the variation in plant water requirements within an irrigation zone enables those requirements to be met more accurately with irrigation scheduling.

Consolidation of plants in zones or blocks to facilitate turning off irrigation in areas not in use can be used to reduce water use, as can reducing plant spacing, provided it doesn't affect plant quality.

The design of production areas can limit the loss of water from environmental factors.

Evapotranspiration (ET) is the term used to describe the sum of evaporation (water moving to the air from the soil, plant canopy and water bodies) and transpiration (movement of water within a plant and the subsequent loss through the leaves).

Evapotranspiration is affected by environmental factors including sunlight, air temperature, relative

humidity, and wind speed.

Purpose built structures that provide crop shading with low shade factors, e.g. hail net materials, can reduce solar radiation, air temperatures and wind, increasing relative humidity and thus reduce ET. Wind breaks and buffer zones can decrease wind effects on the crop, also reducing evapotranspiration losses.



Daily observation of emitters in operation identifies blockages and any significant changes in operating pressure before major crop damage occurs.

Correct operating pressures are critical to the efficient performance of any irrigation system. Check system pressures regularly, and don't rely solely on the pressure gauge at the pump, as this doesn't indicate what the pressure is at the emitter.

Regular filter cleaning helps to ensure the system is working at the correct operating pressure. Automated filtering systems should be checked to ensure they are backflushing correctly.

Regularly checking for and repairing leaks can also reduce the amount of water used. Losses incurred are not only the result of lost water, but also from the reduction in the operating pressure affecting the efficiency of the system. Leaks can also be a potential source of disease contamination within the system.

Develop a system maintenance programme including checking operating pressures, emitter operation, pump operation and filtration and cleaning, repairing or replacing items identified during regular monitoring checks.

To maintain water storages, removal of accumulated sediment may be necessary to improve capacity. Depending on the composition of the sediment, it may be possible to achieve this using beneficial micro-organisms, but if the sediment is non-organic, physical removal will be required. If the storage cannot be emptied the use of a vacuum truck may be an option.

Maintaining drainage infrastructure in systems designed to recycle drainage water will maximise the capture of wastewater. Reviewing and improving the effectiveness of existing drainage water capture can also increase the amount of water returned to water storages, thus reducing overall water use.

Monitoring system performance allows the early detection of problems before they cause significant

crop losses. Each block should have its pressure measured and recorded monthly. A regular efficiency test on each section of the nursery should be done every 6 months to see if the performance is declining, or if there has been a major change in the performance due to other factors, e.g. leaking pipes.

Regular monitoring of overall water use will give information on how much water is being used within the nursery, and how the overall performance compares to Best Management Practice and water use in previous years.

Strategies may need to be put in place if water supplies reach the point where they could run out. In these instances a pre-planned strategy may need to be implemented to extend the existing water supplies. Table 1 is an example of strategies that could be put in place.

Lex McMullin
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Table 1. Water use reduction strategies.

% Water Available	Strategies to Implement
50	Stop non-crop garden irrigation. Check system efficiency and repair leaks. Check drainage collection efficiency. Monitor water quality weekly, and adjust water treatment and fertigation levels accordingly.
40	Reduce mother stock irrigation. Consolidate crop growing areas. Monitor irrigation scheduling closely. Minimise non-essential water use.
30	Stop mother stock irrigation. Monitor dam/bore pump performance daily – pump efficiency will decline and may lead to pump damage at low water levels due to the height water has to be lifted. Rationalise crops. Consolidate water supplies to reduce evaporation. Extend water supplies by blending with poorer quality water.
20	Stop all non essential water use. Ensure scheduling, drainage collection, system efficiency are kept at peak Efficiency and leaks in the system addressed immediately.