

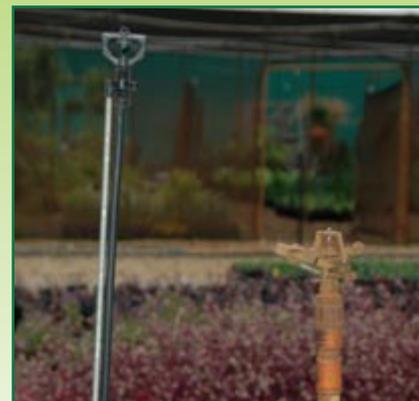
NURSERY PAPERS

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Upgrading an irrigation system can improve water uniformity and reduce your operating expenses

Irrigation is a critical aspect to the success of any business growing and/or maintaining plants. With increased scrutiny of water usage, typically increasing charges in water and a reduced availability, all businesses should consider assessing the efficiency of their irrigation system to improve their triple bottom line.

For many production nurseries the question is how to optimise production while reducing water use and doing this in an economic manner. This is the second part of a series of Nursery Papers on this topic. In this Nursery Paper Michael Danelon, Nursery & Garden Industry New South Wales & ACT (NGINA) Industry Development Officer (IDO) will identify the benefits of retrofitting an irrigation system in terms of the efficiencies gained to assist in justifying the return on investment to the business.



A nursery with old brass impact sprinklers and new Plastro XL 360° sprinklers

Upgrading an irrigation system can improve water uniformity and reduce your operating expenses

Research project focuses on retrofitting nurseries to industry standards

During 2007, the Department of Primary Industries and Fisheries, Queensland (DPI&F Qld) undertook research to 'Increase Adoption of Innovative Irrigation Technologies in Australian Nurseries' on behalf of Nursery & Garden Industry Australia (NGIA).

This is the second part of the research undertaken by DPI&F Qld which focused on retrofitting the irrigation systems of two production nurseries with more efficient technologies to then quantify the potential savings and provide data on the financial feasibility of retrofitting an existing irrigation system.

Irrigation is a critical area in the success of a production nursery and anyone growing plants. For many operators the person who controls the irrigation controls the potential profitability of the business.

Irrigation not only provides water but influences the plant growth by how well (evenly) and appropriately (scheduling) it is delivered to the plant. An excess of water may encourage disease whilst hastening the removal of nutrients from the growing media and rootzone whilst too little can lead to reduced fresh weights of plants, possible accumulation in nutrient salts and variations in plant appearance unacceptable to consumers.



A nursery showing an older sprinkler system (Pope Rotoframes) with a new system (in background)

Nursery retrofit case studies

Two production nurseries in Queensland were identified which were working toward NIASA accreditation, however they required upgrades of their overhead irrigation system but had the potential to collect and reuse runoff within the nursery. Both nurseries were assessed to determine their current efficiency of the irrigation system and ability to collect run off.

An irrigation specialist was commissioned to design and install the irrigation upgrades according to the benchmark criteria

used in water use efficiency under Best Management Practice (BMP) Guidelines, ie Mean Application Rates (MAR) <25mm/hr, Coefficient of Uniformity (CU) >85% and Scheduling Coefficient (SC) of <1.5.

To achieve performance criteria under BMP, the design and retrofitting did not just focus on the sprinklers (type, spacing and height) as it needed to address the performance criteria of pressures and volumes. The layout and position of the sprinklers, filtration, disinfection and operating pressures and

flow rates were addressed to optimise sprinkler performance – refer to Nursery 1 layout performance data – pre and post retrofit (page 3).

Upon completing the retrofit of the two nurseries the water use efficiency and operating cost data were collected and a cost/benefit analysis was carried out to determine the economic implications to each business.

Nursery 1 –

had a 15 year old irrigation system built as the nursery expanded and prior to retrofit used 70% town water (15.2 ML/Yr) and 30% dam water (6.5 ML/Yr) for irrigation:

- Installed and added to irrigate dry areas – variations in system
- Uneven sprinkler spacing and riser heights with multiple sprinkler types
- Irrigation uniformity was poor and application rates inappropriate for media infiltration (Rotors, Lego impacts, Shrub Heads in use)
- Supplemental hand watering and extra irrigations needed to maintain plant growth
- Onsite dam but runoff collection drains inefficient – water pooled in growing beds
- No disinfection system installed
- High occurrence of disease, algal and fungal growth – requiring chemical use
- High number of plant throw-outs & increased labour costs to sort product

The changes to the irrigation system were extensive with a total outlay of \$44,595 for the irrigation system, disinfection unit and labour including:

- Replacing the irrigation system from the existing variable frequency drive (VFD) pump with Hydrovar pump controllers and sand filters (pump station) to achieve irrigation pressures up to 200kPa
- Installation of control and pressure regulating solenoids in irrigation zones
- Installation of new mainline & disinfection coil (increase length of mainline) to improve chlorination contact

time from Aldos EcoOxi chlorine dioxide unit

- Modification to outside bed laterals to 5m x 5m, shadehouse to 4m x 4m and tunnel-house to 3m x 3.6m
- Risers repositioned at 1.5m from ground and inverted sprinklers used in tunnel-house
- New overhead sprinklers – Plastro Rondo XL 360° with brown jets to suit outdoor production type and crops
- New inverted Plastro Rondo inverts 360° with white jets used in tunnel-house and Plastro Rondo inverts 360° with red jets used in shadehouse
- Adjustments to irrigation scheduling to suit new system.

The retrofit allowed a significant reduction in the amount of town water required as less water was being applied and more runoff was being collected and reused within the nursery.

The retrofit allowed annual water savings of 9.4 ML or a reduction of 43% in water usage per annum from the old irrigation system. The major financial savings were in the reduction in town water usage to only 13% of the new water usage equating to a saving of \$24,000 inclusive of associated cost savings of less plant spoilage and labour.

Other benefits of the retrofit are:

- Saved approximately \$19,000 on town water costs
- Greater use of alternative water sources in recycling and nutrient management
- Alleviate pressure on water storages to improve water security in drought
- More uniform plant growth
- Reduced plant throw outs by approximately 5%

- Reduced wet areas throughout the nursery leading to
 - Reduced outbreaks of plant disease
 - Reduced herbicide and fungicide usage
 - Improved irrigation efficiencies
 - Irrigation application rates match media infiltration rates

The economic assessment of the retrofit demonstrates significant financial savings in water which will allow the nursery to see a return on the investment in approximately 3 years with reduced operating expenses thereafter to see a positive return on the investment.



Algae in drains – Nursery 1 prior to retrofitting.



Nursery 1 with Aldos EcoOxi chlorine dioxide unit to disinfect water.

MAR, CU and SC data for Nursery 1 pre and post retrofit.

Old MAR = 8.8mm/hr New MAR = 9.1mm/hr	Old MAR = 7.9mm/hr New MAR = 12.9mm/hr	Old MAR = 11.4mm/hr New MAR = 8.6mm/hr	Old MAR = 6.1mm/hr New MAR = 9.7mm/hr	Old MAR = 11.5mm/hr New MAR = 5.1mm/hr	Old MAR = 13.1mm/hr New MAR = 8.7mm/hr
Old CU = 69.6% New CU = 92.2%	Old CU = 60.4% New CU = 91.6%	Old CU = 68.7% New CU = 92.2%	Old CU = 70.5 New CU = 94.4%	Old CU = 54.4% New CU = 86.5%	Old CU = 66.4% New CU = 91.6%
Old SC = 1.98 New SC = 1.41	Old SC = 5 New SC = 1.36	Old SC = 2.26 New SC = 1.21	Old SC = 3.23 New SC = 1.13	Old SC = 3.63 New SC = 1.35	Old SC = 3.45 New SC = 1.26



Old MAR = 14.6mm/hr New MAR = 10.2 mm/hr	Old MAR = 6.5mm/hr New MAR = 10.5 mm/hr	Old MAR = 13.1mm/hr New MAR = 9.7 mm/hr	Old MAR = 6.5mm/hr New MAR = 10.7 mm/hr	Old MAR = 6 mm/hr New MAR = 8.8 mm/hr
Old CU = 79.6% New CU = 96.3%	Old CU = 82.2% New CU = 90.9%	Old CU = 66.4% New CU = 94.2%	Old CU = 82.2% New CU = 95.9%	Old CU = 47.1% New CU = 95.2%
Old SC = 2.10 New SC = 1.11	Old SC = 6.15 New SC = 1.2	Old SC = 3.45 New SC = 1.12	Old SC = 6.15 New SC = 1.3	Old SC = 7.08 New SC = 1.15

Green values = old irrigation system; Teal values = new irrigation system; Dotted lines show location of catch can tests

Nursery 2 –

had an old irrigation system with 100% dam water for irrigation:

- A 15 to 20 year old irrigation system installed as the nursery grew over generations
- Sprinkler spacing and riser heights were relatively consistent with similar sprinklers
- Irrigation uniformity was average but mean application rates were excessively high (predominantly Moss and Pope Rotoframe sprinklers)
- Used 24.5 ML per year
- Growing beds were well maintained and clean
- Excellent run off collection drains running back to onsite dam were present
- Chlorine dosing system was installed and
- Minimal occurrence of disease on the site

The changes to the irrigation system were significant with a total outlay of \$34,540 for the irrigation system, VFD pump controllers and labour including:

- Upgrading of VFD pumps to VFD pump controllers to achieve 200kPa irrigation zone pressures and pump house for workplace safety
- New control solenoids for all growing areas
- Replaced lateral lines but retained existing mainline
- Modification to outside bed laterals to 5m x 5m, shadehouse 1 to 4m x 4m and shadehouse 2 and 3 to 3m x 3m

- Risers repositioned at 1.5m from ground and inverted sprinklers used in tunnel-house
- New overhead sprinklers – Plastro Rondo XL 360° with brown jets to suit outdoor production type and crops
- New inverted Plastro Rondo inverts 360° with violet jets used in shadehouse 1 and 2
- New Plastro Rondo inverts 360° with white jets used in shadehouse 3 - 5m x 5m for outdoor, 4m x 4m for shadehouse 1 and 3m x 3m for shadehouse 2
- Tailored laterals to suit irregular shaped beds and shadehouse area

Due to the nature of nursery using existing dam water and collection drains, the total savings in water are relatively low. The nursery continued to rely on dam water as the irrigation source with the focus of the nursery to trade during prolonged dry conditions to meet its water demand.

Other benefits of the retrofit are:

- A saving in pumping, maintenance, labour and chlorine costs
- Security of water supply enhanced
- Reduced yearly water use by 24% to 30% (6.5 ML/year)
- Improved irrigation scheduling by the one controller and efficiencies in modification to scheduling
- Reduced wear on pumps from lower operating pressures
- Irrigation line blowouts have ceased – reduced pressure
- Application rates match infiltration rates
- Reduced loss of nutrients from leaching
 - Improved plant growth
 - Maintain water quality of storage
 - Minimised environmental risk

The economic assessment of the retrofit indicates financial savings of \$831 per annum, however with the outlay of around \$35,000 the net benefit over a 10 year period is neutral. Whilst an economic return on the investment is not positive, the ability of the business to operate in drought conditions with improved water security is an investment alone.



Nursery 2 showing older sprinkler system (Pope Rotoframes) with new system installed.



Nursery 2 showing old brass impact sprinklers and the new Plastro XL 360° sprinklers



Inverted Plastro Rondo sprinkler used in shadehouses



Nursery 2 showing irregular shaped bed – combated by splitting the beds and modifying riser spacing to achieve water delivery to plants from 4 individual sprinklers.

Conclusion

The work undertaken demonstrates there are substantial opportunities to save water, however the extent of the savings will be dependent on the individual nurseries water source and the inefficiency of the irrigation system.

The variations in the cost/benefit analysis of the case studies support businesses undertaking an economic assessment to allow them to plan the most appropriate investment to suit their needs.

Financial savings in water costs (substitution) or improvements in water security have very different long term implications and benefits to the business.

With improved irrigation use efficiency there are tangible benefits. These include improved crop performance, water security and reduced run off, and impacts to the environment which need to be considered, in addition to demonstrating water use efficiency, to argue your position as an efficient water user.

References

- Nursery Industry Water Management Best Practice Guidelines (updated 2005) available to download from NGIA website www.ngia.com.au
- Managing Water in Plant Nurseries (2nd edition)
- Nursery Papers May 2006 Issue no. 4, How efficient is your business water management?
- Nursery Paper August 2006 Issue no. 8, Scheduling irrigation to maximise efficiency
- Nursery Paper January 2007 Issue no. 1, Water use in the nursery and garden industry

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