Waste water recycling in nurseries

Introduction

Reducing water run-off, minimising nutrient leaching and optimising irrigation efficiency are major challenges for the nursery industry. A comprehensive review of Australian and international research programs covering all aspects of waste water management in nurseries has been carried out by Horticulture Australia Limited (HAL) - a funding partner for the National Program for Sustainable Irrigation. The review identified useful resources for the industry and best practice in waste water management for nursery operators.

HAL also surveyed more than 100 nurseries as part of the project to help prioritise recommendations for further research to help the industry tackle the issue. Carried out in 2003, the survey showed that more than 70% of the accredited nurseries that responded were using overhead irrigation. Chlorination was the most commonly used disinfestation option. Fifty-five percent were capturing their irrigation runoff, with 80% of these recycling the captured wastewater. About 50% were using pulse irrigation and fertigation techniques.

Irrigation and waste water management best practices

The project identified the following management practices and their potential to optimise water efficiency, improve irrigation scheduling, better manage nutrients, minimise runoff and nutrient leaching, and improve recycling.

Optimising efficiency

- Irrigation efficiency can be improved by grouping plant species and container sizes with similar water requirements into blocks; grouping plants with similar canopy configurations and by ensuring uniform water distribution and regular maintenance.
- Cyclic or pulse irrigation can decrease leachate volumes by 34-71% (compared with continuous irrigation), reduce total effluent levels by 10-14% and cut nitrate losses by as much as 70%.
- Timing watering to occur periodically throughout the day, rather than just early in the morning, can improve plant growth and irrigation efficiency.
- Plant breeding to select cultivars with increased water use efficiency is underway.
- Wetting agents assist in ensuring that the water applied is actually able to be absorbed by plant roots.
- Capillary, ebb-and-flood and drip irrigation systems are all more efficient than overhead systems. Drip systems conserve water and substantially reduce wastewater runoff, without reducing plant growth. However, the lack of economic analysis of these alternatives has meant the majority of nurseries still use overhead systems.

Irrigation scheduling

- Soil moisture sensors are more commonly used in nurseries than evapotranspiration models. Time Domain Reflectromotery (TDR) sensors are most prevalent as they can be manufactured to match container height.
- Managed Allowed Deficits (MAD) identify what percentage of water can be lost to transpiration within a container, before more water should be applied. One approach is to aim for 20%, 30% and 40% MAD for species with high, medium and low water requirements respectively.

Nutrient management

- Fertiliser recommendations are provided based on the amounts needed for a high leaching environment and overhead irrigation. Good plant growth can often be achieved with far fewer nutrients, which in turn means far less leaching of nutrients into waste water. However, the amount of nutrients needed to produce plants in various closed systems is generally poorly understood and plant nutrient uptake rates over time are not known.
- Nutrient charting can help schedule fertigation. It involves monitoring potting media pH, EC and nitrate, plant sap nitrate testing and weekly sampling of leachate.
- Nutrient acclimatisation can reduce nutrient costs, by stopping fertilisation at a given time before the plant is sold. This can achieve nutrients savings of up to 18%.

Minimising runoff

- Increasing the water retention efficiency of potting mix, by adjusting the composite size of the medium, can help to retain water and fertiliser in the rootzone of the plant.
- Hydrophilic gels allow for a reduction in irrigation frequency, however a greater volume of water must be applied at each irrigation to 'charge' the gel.
- Polyacrylamide (PAM) can have nutrient, microorganism and seed immobilizing properties. PAM can help reduce the spread of soil or water-borne microbial problems in runoff water, and may have phyto-sanitation and weed management benefits.

Minimising nutrient leaching

- Granular fertilisers designed to release nutrients gradually can lead to nitrogen leaching in the range of 12-23% compared with 12-48% from liquid fertilisers, particularly if the solid fertiliser is distributed in at least two small amounts rather than in a single application at the start of the rotation.
- Nutrient leaching from pots can be reduced to acceptable levels if organic matter low in available nutrients is applied, as this increases the buffer for nutrients and water in the soil.
- Nutrient retention can be assisted with the addition of aluminium sulphate, pre-charged zeolites or pre-charged clays. These act to slow down the release of phosphorus and potassium.

Wastewater recycling

- Artificial wetlands can remove 60-65% of herbicides from water after two or three days, increasing to 80% after eight days or more. However, most phosphorus removal processes are finite and further work is needed to determine the best ways of managing spike loads and surpluses.
- Research indicates that pesticide residues do not generally pose a problem in nursery waste water recycling systems. Herbicides should be applied to individual containers rather than being broadcast.
- Infestations of pathogens, viruses, nematodes, bacteria and weed seeds can be handled by either active means (using chlorine, bromine, chlorine dioxide, chlorbromination, heat, UV, ozone, flame, hydrogen peroxide, iodine, peroxyacetic acid or calcium hydroxide) or passive alternatives (slow filtration, bioaugmentation or use of biological control organisms).
- One system of integrated disease management uses a combination of slow sand filtration, to disinfect the nutrient solution, and *Pythium oligandrum* to colonize and protect plant roots from pathogenic attack. However, more research needs to be carried out to incorporate Integrated Pest Management principles and better understand the suitability of various systems.
- Slow sand filtration is evolving as a major disinfestation technique. However, while it is effective in controlling *Phytophthora* and *Pythium*, the technique is less effective in controlling Fusarium, viruses and nematodes. Water pH levels and the temperature of the solution being used also affect its ability to control pathogens.

Further information

A full copy of the 72-page HAL review has been published under the title *Audit and Gap Analysis of Nursery Waste Water Recycling Research and Communication*, Horticulture Australia Report No. NY02024. Lane, V (2003). Another HAL project to follow up is titled *Constructed Wetlands to Reduce Nutrient and Pathogen Loads in Recycled Nursery Water*. The reference for the 111-page report is Horticulture Australia Final Report NY98008. Huett, DO (2002).

Both reports can be obtained by:

- Writing to Horticulture Australia Limited, Level 1, 50 Carrington Street, Sydney, 2000.
- Phoning HAL on 02 8295 2300 or send a fax to 02 8295 2399.
- Email: danika.houghton@horticulture.com.au.

The National Program for Sustainable Irrigation is also funding a project exploring the benefits and issues relating to using recycled water for horticulture in Australia. The work is being carried out by Victorian Department of Primary Industries horticultural scientist Anne-Maree Boland. For more information contact:

- Program coordinators Murray and Liz Chapman on (03) 5763 3214 (email: rplan@benalla.net.au), or
- Principle investigator Anne-Maree Boland on (03) 9210 9222 (email: Anne-Maree.Boland@dpi.vic.gov.au).

Further information about the project and National Program for Sustainable Irrigation is also available by:

- Contacting the Program Officer, phone (02) 6263 6005, fax (02) 6263 6099 or email joanne.caruso@lwa.gov.au.
- Visiting the Program website, www.npsi.gov.au.
- Writing to the Program, c/o Land and Water Australia, GPO Box 2182, Canberra, ACT, 2601.

The website also features a Knowledge Base page which is a very useful starting point for identifying information sources and lessons learnt from research into sustainable irrigation, not just in Australia but overseas. The Knowledge Base is a free searchable on-line database.

About the Program

The National Program for Sustainable Irrigation focuses research on the development and adoption of sustainable irrigation practices in Australian agriculture. The aim is to address critical emerging environmental management issues, while generating long-term economic and social benefits that ensure irrigation has a viable future. The Program has 14 funding partners: Land & Water Australia (Managing Partner); Sunwater, Queensland; Horticulture Australia Limited; Goulburn-Murray Water, Victoria; Cotton Research and Development Corporation; Harvey Water, Western Australia; Lower Murray Water Authority, Victoria; Wimmera Mallee Water, Victoria; Ord Irrigation Cooperative, Western Australia; Australian Government Department of Agriculture, Fisheries and Forestry; Department of Natural Resources and Mines, Queensland; Department of Primary Industries and Resources South Australia; Department of Environment Water and Catchment, Western Australia; and Department of Agriculture, Western Australia.