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Driving better vegetable irrigation through profitable practice change.

Project no: VG07023

Tried and tested irrigation solutions for vegetable producers.

National greenhouse waste-water recycling project.

Project no: VG09073

Pouring wastewater down the drain is viewed as environmentally irresponsible by the public and is not financially viable for a business and as a result greenhouse growers are being trained to change their methods of waste water management.

Driving better vegetable irrigation through profitable practice change

Placement of Soil Suction Extraction tubes in a drip irrigated lettuce crop

Introduction

The availability and quality of irrigation water is a long-term issue for Australian vegetable growers, however producers looking to new technologies for more profitable production often discover that practical information is limited. In a Horticulture Australia Ltd funded three year project, scientists from Queensland and New South Wales Government departments and the CSIRO investigated technology improvements applicable to growers.

The Project

The project team conducted nine detailed experiments in the Lockyer Valley and Riverina vegetable districts, as well as case studies with growers in southern Queensland.

"We were looking to see which technologies were practical and delivered desirable outcomes for both the producer and the broader community," explained project leader and principal horticulturist Craig Henderson, who works with Agri-Science Queensland. "We were also looking to reduce constraints that make technologies less adoptable."

The team investigated: root zone monitoring tools (FullStop™ wetting front detectors and Soil Solution Extraction Tubes - SSET), drip system layout, fertigation equipment and altering planting arrangements. It also developed and validated models for broccoli, sweet corn, green beans and lettuce, as well as spreadsheets for evaluating economic risks associated with new technologies.

"We wanted to establish which irrigation improvements made sense in particular growing circumstances. We're providing information on how to best use them, the practical considerations and risks associated with their adoption. We wanted to develop analytical tools that could predict the impacts of technologies on crop performance, environmental impacts, and economic outcomes for producers," explained Mr Henderson.

Fullstop placement in a drip irrigated lettuce crop monitoring tool

The outcomes were presented at more than 100 extension events, including irrigation showcases, conferences, field days, farm walks and workshops.

Major Findings

Managing solutes in vegetable root zones

Due to the level of expertise and labour required, root zone tools are recommended to address specific problems - or as a periodic auditing strategy - rather than routine monitoring.

- FullStop™ wetting front detectors are excellent for monitoring root zone conditions (EC, nitrate levels) in vegetables. The detectors are built around a buried funnel that concentrates wetting fronts into a reservoir which can then be withdrawn via a tube. They help to pinpoint the movement of water, salts and nitrogen in the soil; particularly beneficial when irrigating with poor quality water or fine-tuning fertigation. FullStop™ instruments should be installed in pairs, a shallow instrument within the main root zone at a depth that regularly triggers after each significant irrigation, and a second below the root zone (but no deeper than 60 cm).

- Soil Solution Extraction Tubes (SSET) extract water from the surrounding soil through a ceramic tip and are useful for detecting salts or nutrients in deeper soil zones beyond the depth range of the FullStops™. They only work effectively when the soil is moist-wet, and should be installed in pairs; with one shallow instrument within the main root zone and a second below the root zone.

Optimising drip irrigation infrastructure, fertigation technologies and planting arrangements

Positioning drip irrigation tubes close to crop rows (<8 cm) improves nitrogen uptake and water use efficiency and reduces the risk of crop stress during establishment. It also provides more options for managing salty water and more flexibility in taking risks with forecast rain. A cheaper alternative would be to push crop rows closer to the drip tube, leading to an asymmetric row structure.

Biophysical modeling

The vegetable crop models developed by the CSIRO effectively predict crop phenology (e.g. harvest date), input use (water, fertiliser), environmental impacts (nutrient, salt movement) and total yields. The models are available through the APSIM platform (based at www.apsim.info) and are intended for use by experienced or trained users (scientists, consultants), either in group situations with growers in workshops or as a service to individual farmers.

Conclusion

This research has led to recommendations for root zone monitoring and improved efficiencies in drip irrigation infrastructure. It has also highlighted the potential of a range of diagnostic, economic and analytical tools suitable for irrigation consultants. Through web-based information packages, ongoing consultation and the establishment of a core of industry and commercial expertise in these practical irrigation technologies, the project team is confident that improvements are possible for growers.

The Bottom Line: VG07023

- Limited practical information on technological innovations in irrigation has impeded productivity for vegetable growers.
- Root zone tools are recommended to address specific problems - or as a periodic auditing strategy - rather than routine monitoring.
- Close proximity of the drip tube to the crop row also offers a range of benefits.

Acknowledgements

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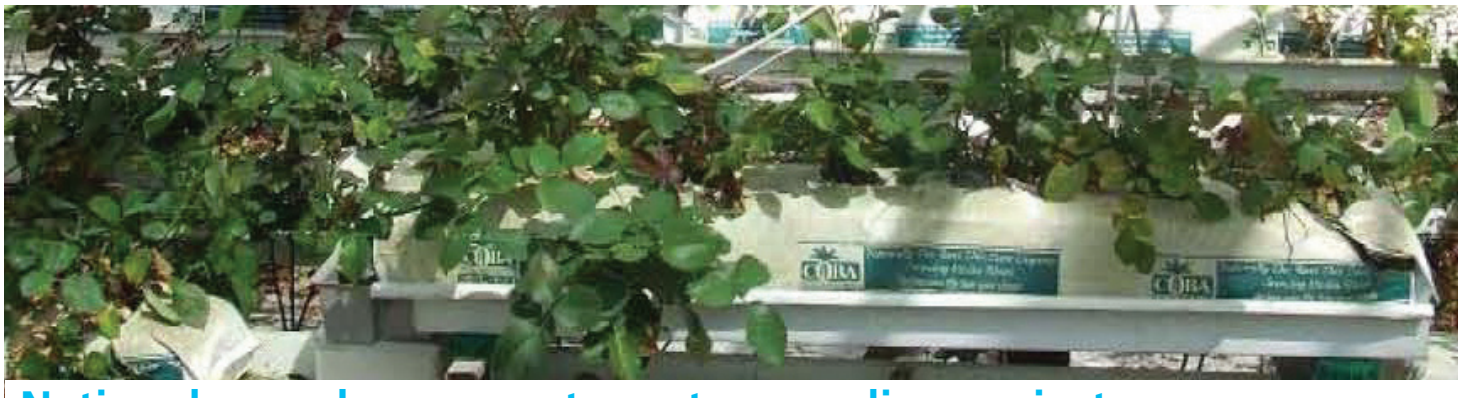


National greenhouse waste-water recycling project

Media based recirculation system

Introduction

The Australian protected cropping industry is housed in more than 1,300 hectares of greenhouses around the country and is made up of approximately 1,665 growers. While greenhouse production requires around one fifth of the water volumes used in more traditional farming activities, up to 95 per cent of growers have been using 'open' systems which free-drain their nutrient rich waste-water into the environment. This project encouraged growers to convert to 'closed' systems which safely treat and recirculate recycled waste-water back to the crop.

About the Project

A research team made up of Graeme Smith (Graeme Smith Consulting) and Rick Donnan (Growool Horticultural Systems) collated the technical knowledge and information required to enable growers to efficiently convert their greenhouse waste-water systems. A literature review was conducted to assess the current information available, identify global world's best-practice and address any knowledge gaps.

A grower training package was also developed and delivered at a series of theoretical and practical workshops in key Australian growing areas. The workshops demonstrated the types of recycling equipment available and shared information on nutrient feed recipes, root-zone nutrition targets, interpretation of laboratory drain analysis results and sterilisation options.

Basic Design Principles for Closed Systems

- Drain and recirculation tanks to hold ± 2 days recirculated water (based on around 50 per cent drain per day)
- 3-way valve should be automated
- Different Pre-EC set-points for different crops (ideally should be calculated and adjusted regularly)
- Feed recipes vary from free-drainage systems; however root-zone targets remain the same
- Drain analysis in order to ensure that the system is stable and balanced should take place one month after planting, then every 2 - 3 weeks in summer and every 3 – 4 in winter. Same principles apply if nutrient batching or directly injecting fertilisers
- Run disinfection system at night when system is stable
- Allow bypass at organic filter for temporary free drainage (and first week or two to discharge any unwanted waste material)
- Fit one-way (check) valves to stop any backflow or syphoning
- All fittings to be PVC, poly or stainless steel to avoid corrosion or contamination of water
- Minimum pre-filtration for all sterilising systems ±40µm
- Drain analysis always from the drain tank (however allow for recycle tank losses following sterilisation treatment)

- Nutrient/water mixing always on low-pressure (suction) side of pump
- Ideally all drain water captured in pipe systems and kept isolated from the ground (to avoid cross contamination)
- Perform dripper audit to ensure system/numbers are correct
- Adaption recipes for a maximum of two weeks to avoid over-correction

Major Findings

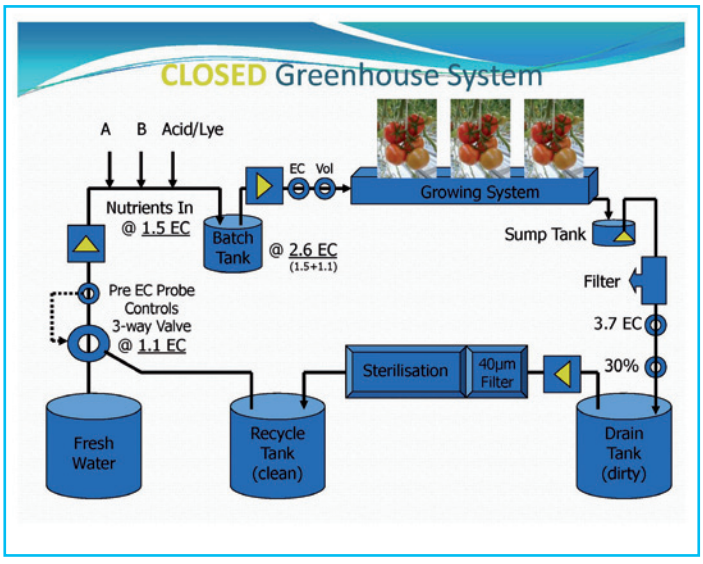
Closed systems not only have environmental benefits but can produce some significant savings, with 40 per cent less water use and 60 per cent less fertiliser use resulting in an average annual saving of $15,000 for every 4000m2 greenhouse system. The project also identified several useful resources for producers:

- The book Plant Nutrition of Greenhouse Crops (Sonneveld & Voogt, Springer Publications) provides sound advice on optimising water and fertiliser uptake and covers all the conventional nutritional recipes and adjustments for traditional and emerging greenhouse crops and growing media.
- Haifa Chemicals Limited's software program Haifast assists greenhouse growers to develop their nutritional recipes based on analysis of their fresh water supply/s and drain water. These recipes are then automatically adjusted to the normal standard feed recommendations for crop age and physiological stages. This resource will greatly simplify greenhouse growers' ability to balance their crop nutrition when converting to a 'closed' recycling system, and is available at www.haifachem.com.
- The industry workbook distributed at the workshops will be uploaded onto the Protected Cropping Australia website at www.protectedcroppingaustralia.com. An 'e-book' is also undergoing development in order to ensure ongoing delivery of skills to all of industry.

Conclusion

This project has provided the tools to convert to 'closed' systems which not only reduce waste-water effluent to negligible levels, but allow it to be re-used on crops. It has the capacity to deliver an annual benefit to industry of $25 million and divert around 5 giga-litres of nutrient-rich water from impacting on the natural environment.

Pathology issues and outcomes and sterilising treatment options are also relevant to soil growers, resulting in flow-on benefits for soil greenhouse growers as well. Improved techniques should translate into improved production and quality and enhanced market opportunities.



The Bottom Line: VG09073

- Greenhouse growers are being equipped with the skills and technology required to convert open drainage to closed waste-water systems.
- Low investment can create high returns by slashing 40 per cent off water costs and 60 per cent off fertiliser costs.
- Recycling waste-water will result in potential savings of $25 million at an industry level and prevent around 5 giga-litres of nutrient-rich water from impacting on the natural environment.

Lined basin to harvest rainwater

Acknowledgements

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PO Box 2042, Camberwell West, Vic, 3124
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