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HAL R&D project number: VG07144

Project VG07144 created a best practice manual for conversion to simple hydroponics aimed at existing protected cropping growers interested in converting from soil-based production to hydroponics. It will also have application for growers looking to upgrade their hydroponic systems.

- **Design and demonstration of precision agriculture irrigation applied to different vegetable crops.**

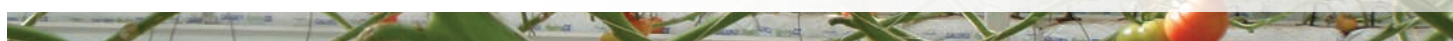
HAL R&D project number: VG08029

Project VG08029 aims to develop and investigate two retro-fit irrigation technology systems to improve water use efficiency, reduce energy costs and reduce environmental impact during vegetable production.





Improving greenhouse systems and production practices.



Tomato crop grown in hydroponics-layering allows crops to be grown for longer than in soil.

Facilitators:

The final report of project VG07144 has been completed by Project Leaders Dr Kaye Ferguson and Barbara Hall of the South Australian Research and Development Institute (SARDI), with the collaboration of researchers: Jeremy Badgery-Parker, Keith Webb, Tony Burfield, Domenic Cavallaro and Sophie Parks.

Introduction

Poor soil health, soilborne diseases, soil salinity and increasing pressures on production, continue to hamper rates of productivity for many growers. Hydroponic systems do not use soil, the crop's water and nutrient requirements are supplied entirely via a nutrient solution. Production takes place either in a protected structure (greenhouse) or outdoors and systems can be designed to reuse nutrients on the hydroponic crop or on other crops (e.g. trees, pasture improvement, etc.).

Research findings

Hydroponic technology has proven to provide a commercial alternative to soil-based production, with significant crops including: tomatoes, cucumbers, capsicum, lettuce, strawberries, Mediterranean and Asian herbs and Asian greens. There are still however, soil-based growers who are reluctant to move into hydroponics due to set up costs, high technological input and the lack of expertise available. Following consultation with industry partners, project VG07144 created a best practice manual for conversion to simple hydroponics. Aimed at existing protected cropping growers interested in converting from soil-based production to hydroponics, it will also have application for growers looking to upgrade their hydroponic systems.

Project Leader Dr Kaye Ferguson said: "Growers did not know who to talk to, what systems were available and weren't sure where to get information and equipment from. They also wanted to know how to actually go about the process of converting to a hydroponic system."

Demonstration sites

In conjunction with another similar research project - VG08064: 'Developing demonstration sites for simple hydroponics in protected cropping', three demonstration sites were established on commercial properties showcasing conversions from soil production to hydroponics. The sites, which included two on the northern Adelaide plains, grew commercial crops of cucumbers and tomatoes. Field days were also held at the demonstration sites throughout the project, where growers could tour the sites, communicate with other growers about how conversion was

undertaken and gain a better understanding of the equipment utilised.

"In some cases, yields were three to four times higher in crops grown with hydroponic systems compared to soil crops," said Dr Ferguson. "Obviously it takes a level of investment to get into hydroponics, but that kind of yield increase means that growers can pay off that investment in a reasonable time frame." The sites aimed to give growers first-hand experience of what could be achieved with simple hydroponic systems even without climate control, disseminate information to growers through field days, and develop a companion DVD illustrating issues for consideration outlined in the manual.

Major project findings

Although the manual does cover basic management of hydroponic systems, it is not designed to be a text on how to do hydroponics; instead it outlines what growers need to think about before a conversion is undertaken. "There were several misconceptions amongst growers about going into hydroponics which we have tried to address in the best practice manual," said Dr Ferguson. "Some growers thought that a hydroponic system would help control the climate in a greenhouse, which it doesn't, only a climate control system can do that. Others thought that going into hydroponics would give them complete control over a crop, and it does not do that either. What it does do is give growers more control over the root zone which is a very important aspect," she said.

Water use efficiency was significantly higher when compared with soil-based crops and a return on investment was estimated within two to six years, depending on the system installed and the crops grown.



Cucumber crop at demonstration site 5 weeks after transplanting.

Conclusion

The manual highlights the importance of having an overall plan for converting to hydroponics and how a step by step approach to conversion can make the process manageable and less risky. The manual aims to assist the grower in examining their reasons for converting to hydroponics, explains the basics of hydroponic systems and management, emphasises what hydroponic systems can and cannot do for a grower's business and outlines the steps in conversion. The manual also ensures growers are well informed about some of the limitations of hydroponic systems and assists growers in constructing a good financial plan and predicting a timeframe in which a return on investment can be made.

The best practice manual is expected to be released in August/September of 2012. Notification of the manual's publication and instructions on how to obtain a copy will be promoted in the following industry magazines:

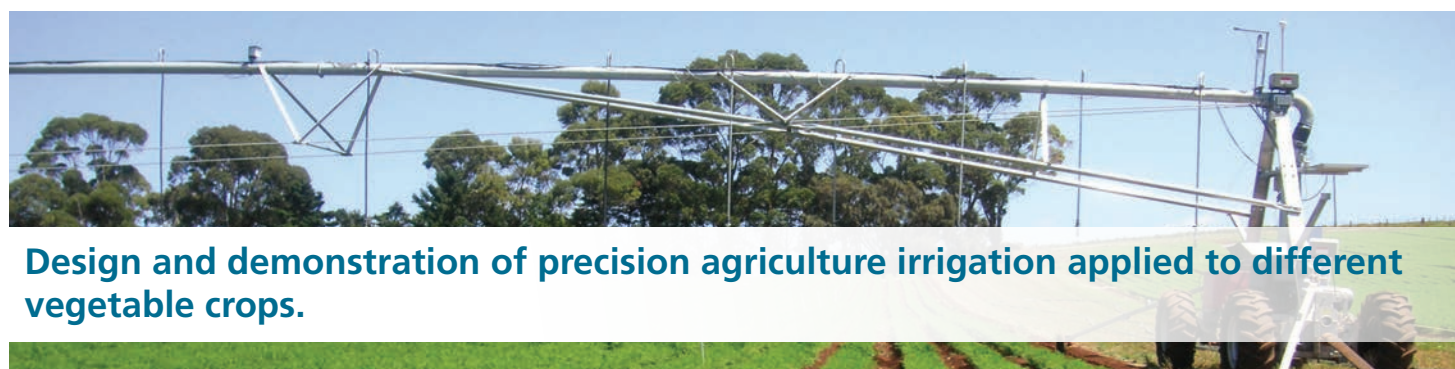
- Practical Hydroponics and Greenhouses
- Soilless Australia
- SA Grower

The Bottom Line: VG07144

- A best practice manual for conversion to simple hydroponics from soil-based production systems was developed in project VG07144 and is expected to be released in August/September of 2012.
- Demonstration sites exhibiting conversion to hydroponic systems were set up to compare yields and productivity with soil-based systems and facilitate communication with other growers – in some cases, yields were three to four times higher in simple hydroponic systems. Water use efficiency was also significantly higher when compared with soil-based crops.
- Hydroponic systems are often favoured for their high levels of efficiency in their utilisation of inputs including water, fertilisers, labour, land and energy.

Acknowledgements

This project has been funded by HAL using the National Vegetable Levy and matched funds from the Australian Government.



Design and demonstration of precision agriculture irrigation applied to different vegetable crops.

The variable rate system on the linear move irrigator in field.

Facilitators:

Milestone 8 of project VG08029 has been completed by Project Leader Dr Susan Lambert with the assistance of Dr Frank Hay, Dr Bill Cotching and Professor Tony Norton, from the Tasmanian Institute of Agriculture (TIA) - a research branch of the University of Tasmania. Daniel Hugo from the Information and Communication Technologies (ICT) Centre of CSIRO also worked on the project.

Introduction

One of the key financial pressures faced by vegetable growers throughout the industry is the rate of rising input costs; particularly, the cost of crop irrigation. The aim of project VG08029 is to develop and investigate two retro-fit irrigation technology systems to improve water use efficiency, reduce energy costs and reduce environmental impact during vegetable production.

Research background

Two commonly used irrigation systems in Tasmanian vegetable production have been used in the project - a linear move irrigator and a big gun travelling irrigator. Although big gun travelling irrigators are relatively inefficient in terms of

energy and water consumption – as well as being an aging technology – they remain popular in the vegetable industry due to effective portability and low capital cost. The research also retro-fit a linear move irrigator with new technology to enable communication with a network of soil moisture sensors across the field (provided by CSIRO ICT) and the foundation of a decision support system to enable site specific irrigation. A cost-benefit analysis was conducted to compare the technology to current irrigation practices over a three year rotation of vegetable crops at the Tasmanian Institute of Agriculture - Vegetable Research Facility.

Major project findings

Project Leader Dr Susan Lambert said trials conducted over three consecutive vegetable growing seasons (2010-2012) using a pressure control system retro-fitted to a travelling gun irrigator indicated energy savings of 17-21.8% and water savings of 5-10%.

"If a crop receives 4ML/ha of irrigation, and the cost of electricity is sitting at \$0.22/kWh (day rate) then a 17-21.8% saving represents \$64.30-\$82.45/ha," she said.

Frequent rain events in 2012 reduced the requirement for irrigation applications, but still resulted in an estimated 10% saving of water. The project also investigated the integration of soil moisture measurements collected in real-time from a wireless sensor network (WSN) developed by the CSIRO ICT to schedule irrigation events applied with a linear move irrigator fitted with variable rate irrigation (VRI). Over the three cropping seasons the variable rate system operated with estimated water savings of 10-15%. Challenges across the differing growing seasons, 2009-2011, included high and frequent levels of rainfall which hampered the efforts to examine the irrigation work.

“In all three seasons yield was significantly higher from the modified irrigation systems when compared to the conventional traveller gun irrigation treatment, with increased yields of 14.6% in beans in 2010, 10% in carrots in 2011 and 14.8% in beans for 2012 growing seasons, respectively,” said Dr Lambert. Economic evaluation results from the study suggest the pressure control system for the travelling gun irrigator was economically beneficial under the trial conditions. Dr Lambert cautioned that it is of fundamental importance to know the soil moisture variability within a field in regards to site-specific irrigation management, given that different water holding capacity occurs in different soils.

“The retro-fitted component of the technology developed in this project demonstrates an innovative approach to address issues of sustainable natural resource management, adapting to climate change challenges and responding to increases in energy costs,” she said. Dr Lambert also stated that with the proven savings in water expenditure and energy consumption displayed in the project work, it is plausible to estimate that the cost of the modified traveller irrigation system could be recouped in 2-3 years.



Irrigator control systems for variable rate irrigation (VRI) system on linear move irrigator.

Conclusion

Several considerations need to be taken into account before growers seek to adopt new technologies to save energy and water. These can include an assessment of the variability and suitability of vegetable cropping fields for retro-fit irrigation technology such as VRI. Individual on-farm assessments to determine potential economic benefits of VRI for growers, sensor placement and selecting the number of sensors require careful planning to maximise VRI potential. Auditing of irrigation energy use on-farm and distribution uniformity of irrigation equipment is also required to ensure irrigation systems are performing to their optimum prior to any retro-fit irrigation technology.

The Bottom Line: VG08029

- Using a pressure control retro-fitted system to a travelling gun irrigator showed an energy saving of 17-21.8% and water savings of 5-10%.
- With the proven savings in water expenditure and energy consumption displayed in the project, it is reasonable to estimate that the cost of the modified irrigation system could be recovered in 2-3 years.
- Variable rate irrigation (VRI) using a network of soil sensors and a modified linear move irrigator also led to water savings.

Acknowledgements

This project has been funded by HAL using the National Vegetable Levy and matched funds from the Australian Government.

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VG08029 photos credit Dr Susan Lambert

*Please contact Courtney Burger at AUSVEG on 03 9822 0388 or email courtney.burger@ausveg.com.au to submit topics for potential inclusion in future editions of **vegenotes**.*

ISSN: 1449 - 1397

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This project has been funded by HAL using the National Vegetable Levy and matched funds from the Australian Government.

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