

Subsurface irrigation

Introduction

Australian studies show an average of 30% of applied irrigation water passes through the root zone without being used by the crops it is intended to sustain. This water either becomes groundwater recharge or is intercepted by drainage networks and contributes to waterway pollution.

Subsurface drip irrigation has shown great potential for increasing crop yield and uniformity, while decreasing water use and environmental impact. Importantly, subsurface irrigation applies water directly to the plant's root zone at a rate closely matching that required for optimum plant growth.

Pros and cons

Subsurface irrigation offers a range of benefits to irrigators and the environment, including:

- Uniform water application throughout the field
- Less crop water stress
- Water does not leave the soil unproductively through evaporation or drainage
- Fertigation can be more readily employed, with precise application rates and timing to match the crop's lifecycle, while avoiding weed growth
- Flexibility in design to readily take account of irregular-shaped fields
- The possibility of precision irrigation, with dry areas for tractor movement at any time.

Potential disadvantages may include:

- Greater financial investment required to set it up
- Difficult to install and remove
- Barrier to root growth - roots may intrude into emitters causing blockage
- Increased risk of waterlogging and soil tunnelling
- Limited cultivation options
- A secondary irrigation method is required to aid crop establishment for systems installed at a depth greater than 0.1m
- Drip tape disposal or re-use needs to be planned for, with extra costs in removing it at the end of its useful life.

The economics

Studies of the economics of subsurface irrigation have been conducted for field corn and sugar cane. In both studies, centre pivots were found to be more profitable. Compared to pivot sprinkler systems, subsurface irrigation generates greater returns to management and investment but it is less profitable when the annual ownership costs associated with the greater initial investment are included. The relative returns are also sensitive to the life span of the system, the scale of initial investment and relative crop yields.

General conclusions

According to researchers and technical advisers in the field, some improvements need to be made to the commercial products currently available and common management practices to achieve maximum efficiency in current subsurface irrigation systems.

For example:

- Water application rates must be low enough to support 'slow' wetting of the soil to protect soil structure
- Control systems must include real time sensor feedback and be flexible enough to maintain optimal soil conditions at all times of crop development
- Knowledge of soil hydraulic properties needs to be incorporated into system designs
- The economics of subsurface irrigation need to be considered against the cost of water, return on produce, soil characteristics and environmental risks.

Further information

As part of its efforts to focus research on the development and adoption of sustainable irrigation practices in Australian irrigation, the National Program for Sustainable Irrigation part-funded research by CSIRO Land and Water irrigation scientist Dr Philip Charlesworth into subsurface irrigation systems under field conditions. The research contributed to his PhD thesis, completed in 2003 through the Charles Sturt University, School of Agriculture. The final 166-page paper has been published by the Program as part of its Irrigation Research CD.

The CD is 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. Kansas State University also has a great website on Subsurface Drip Irrigation. Go to <http://www.oznet.ksu.edu/sdi/>

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.