Getting to the bottom of deep drainage

By John Sanderson

Queensland scientists have achieved a world first by using lysimeters to measure water lost beyond the root zone of plants.

The work will help cotton farmers understand and reduce deep drainage in irrigated cropping areas, thus becoming more water efficient.

Twenty-one drainage lysimeters have been placed under the root zone of cotton plants in the Condamine-McIntyre-Balonne and Emerald irrigation areas. It is being funded by the Queensland Government in its newly initiated Rural Water Use Efficiency Program, Stage Two (RWUEII).

The work is backed by the Australian cotton industry, the Cooperative Research Centre (CRC) for Irrigation Futures and the CRC for Cotton.

Principal Scientist with Natural Resources and Mines, Dr

36 ▷

The deep drainage recording equipment with Stewart Leadbetter, at left, on his "Cabarita" cotton farm near Pittsworth and NRM's Des McGarry.

◁ 35...DEEP DRAINAGE

Des McGarry, said that many growers have done the hard work of introducing controlled traffic, permanent crop beds and break crops but the time has come to get to the bottom of deep drainage.

Poor environmental management

"Deep drainage is a form of poor environmental management that can be sustainably managed today through altering on-farm practices," says Des.

"Excessive deep drainage of irrigation water is both an inefficient use of a limited resource and has strong potential to contribute to rising water tables, salinity and water quality problems."

The Condamine-McIntyre-Balonne research is focussing on seven irrigated cotton farms representing the key cotton growing soils in the area between Pittsworth, Dalby, Goondiwindi, Dirranbandi and St George.

At each site, three recording "drainage lysimeters" have been installed close to the top, middle and tail ditch-end of each field.

In a world first, 21 lysimeters have been placed beneath the root zone of the cotton plants. Lysimeters are large undisturbed soil cores instrumented with a suction drainage and logging system to measure and collect the lost water.

Des McGarry, principal scientist NR&M, at left, explains the deep drainage recording equipment to Glenn Fresser, on his "Mayfield" property near Dalby.

A WORLD FIRST

Despite this being a ground-breaking procedure in irrigation hydrology, measuring leakage below the crop root zone with lysimeters has become an almost routine task for NR&M.

Cotton grower Stewart Leadbetter, Pittsworth, has three lysimeters installed in one field on his "Melrose" property near Pittsworth.

He knew Des 15 years ago when he travelled the State for the Department conducting soil pit field days on cracking clay soils.

"We've got our soil quality sorted out and now I want to know if I am losing water through deep drainage below the root zone," says Stewart.

"We know that our improved land management practices, controlled traffic, reduced tillage and growing rotation crops, has increased the water going into the profile.

"But we need to know that we are using this water in the most efficient way and not losing it to the groundwater," said Stewart

Switched on growers

Glenn Fresser has greyer soil, not as forgiving as the black soils. He doesn't have the high clay or calcium content, but it is equally as good a cotton growing soil as Stewart's Pittsworth soil.

Like Stewart, Glenn has three lysimeters installed in one field on his farm. Glenn has done all the work to support water use efficiency, but the NR&M monitoring can tell him if he is getting maximum benefit and he can make adjustments accordingly.

The cotton industry considers that it keeps abreast of water use efficiency. Many growers have fields that drain surface water on and off efficiently, so the lysimeters will provide vital input into this important research on leakage rates.

Des says that the water that passes through the lysimeters is continuously monitored and the actual water is collected for analysis.

"A practical end-point will be the capacity to relate scientific measures to on-farm management practices capable of being adjusted to minimise deep drainage — practices such as designing field slope and length, water application rate and groundwater pumping and safe disposal of poor quality water," Des said.

Cross checking results

The researchers in the projects are not relying solely on their lysimeters to measure deep drainage. Careful "cross checking" is underway with three other indirect methods to quantify deep drainage.

The first uses water meters in irrigation siphons to measure the rate of water flow onto a field at each irrigation. Then the advance rate of the irrigation water down the field is measured with wetting front apparatus.

This data is put through the Surface Irrigation Computer Simulation Model (SIRMOD) that has been developed at the NCEA (the National Centre for Engineering in Agriculture) in Toowoomba.

This allows prediction of the water infiltration at any point in the field. This data is then combined with evapotranspiration data to calculate deep drainage by difference.

A second method estimates deep drainage using the SODICS model based on the difference in soil chloride profiles (to 1.8 metres) at the start and end of the cotton seasons.

Early analysis of the experimental data shows deep drainage amounts, over a single cotton season, can vary from 50 millimetres to 260 millimetres. The collecting of data on a wide range of environmental and farm management conditions will continue for several years.

Additionally, the consequence of the deep drainage values on ground water response is being explored using the available hydrogeological records of the water levels underlying each irrigation area.

Feedback for farmers

In the Condamine-Balonne-McIntyre and Emerald regions, several farmer field meetings will be conducted to ensure feedback of data to the local irrigators, staff of the various government agencies and local irrigator and farming system associations.

Des said that farming efficiency was so advanced today that recent deep drainage investigations should be viewed in terms of Smart State technology.

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