Less water with late water

- results from delayed permanent water experiment

Brian Dunn[1], Don Gaydon[2] & Colin Dunn[1]

[1] NSW Department of Primary Industries, Yanco, [2] CSIRO Sustainable Ecosystems, St Lucia Qld

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- The delaying of permanent water resulted in reduced water use, but whether water productivity ($/ML) is increased will depend on grain yield
- Any financial benefit from delaying permanent water will be determined after grain harvest
- Research into nitrogen management and greenhouse gas emissions of the delayed flood practice is necessary

After selecting a non-leaky field, growing a shorter season variety and managing the crop to achieve maximum yield, the next best opportunity to increase water productivity for rice may be to delay the application of permanent water.

There is an opportunity to save water needed by rice crops by reducing the evaporation losses that occur from the exposed water surface in the period between the traditional time of permanent water application and when the rice crop canopy covers the water surface.

Research by John Thompson in Deniliquin (reported in IREC *Farmers' Newsletter* No 173: Spring 2006) where rice was flush irrigated at intervals of 50–60 mm cumulative evapotranspiration (ET) until just before panicle initiation (PI), gave water savings of 10–20% with little reduction in yield. In a bid to reduce water use, some farmers have been severely moisture-stressing their rice crops before applying permanent water (reported by Whitworth and Lacy, *Farmers' Newsletter* No 179: Spring 2008). The amount of water saved and rice yield achieved depends on how stressed the rice becomes and how late permanent water is applied.

Measuring the benefits

A replicated experiment was established in spring 2008 at Yanco Agricultural Institute where rice was irrigated at a range of moisture stress levels until just prior to panicle initiation when permanent water was applied. The aim of the experiment is to quantify water use for each level of moisture stress and measure plant growth and grain yield. The financial consequences of irrigating rice at different levels of moisture stress can then be determined. The experiment will also be used to test and improve the performance of the APSIM farming systems model, which can subsequently be utilised to extend the learnings from this experiment to a range of different season types. The model will also be used to examine the impact of this practice on other crops in rotation, and whole-of-farm water productivity. It is hoped the experiment will continue for two years.

***Figure 1**. Aerial photo of delayed permanent water experiment, 26 January 2009*

Irrigation treatments

The experiment has four irrigation treatments:

1. **Flooded** – a traditional conventional combine sown treatment = 3 flush irrigations then permanent water at the 3 leaf stage, 18 Nov.
2. **40 mm ET** – flush irrigations every 40 mm ET = 11 flushes then permanent water 3 Jan.
3. **80 mm ET** – flush irrigations every 80 mm ET = 6 flushes then permanent water 2 Jan.
4. **160 mm ET** – flush irrigations every 160 mm ET = 4 flushes then permanent water 1 Jan.

Panicle initiation was reached 12–16 January with the flooded treatment reaching panicle initiation first and the 160 mm treatment last.

Nitrogen management

Nitrogen management in an intermittently flushed irrigated system is different to when rice is grown under ponded conditions – the intermittent flushing leads to increased nitrogen losses.

Each treatment received three rates of nitrogen, 0, 135 and 200 kg N/ha. In the flooded plots 2/3 of the nitrogen was applied prior to permanent water and 1/3 at panicle initiation. The delayed permanent water treatments received three equal split nitrogen applications. The first two were applied to dry soil then ponded for two days. The third application was applied to dry soil prior to permanent water.

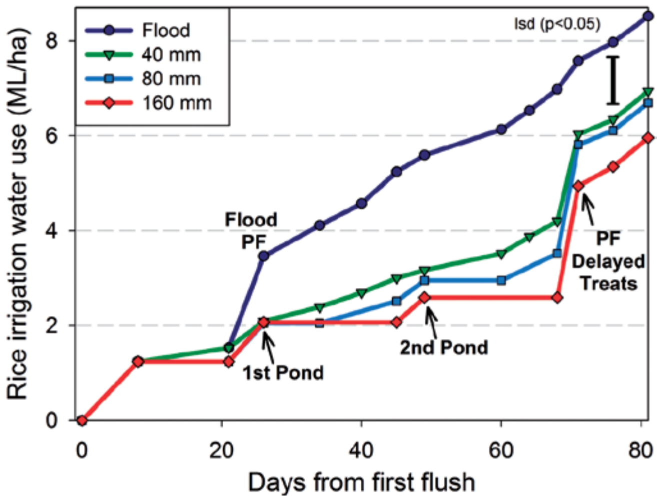

Figure 2. *Rice irrigation water use for flooded and flush irrigated treatments*

Weed control

Weed control was not the focus of the experiment and herbicides were applied to ensure weed infestations did not compromise the experiment. The use of commercially available herbicides, applied before barnyard grass reached tillering, provided excellent weed control in all treatments.

Irrigation water use

One week after all delayed water treatments received permanent water, all treatments were filled to 100 mm water depth. This was a good time to compare water use between treatments as any soil moisture depletion of treatments that occurred has been refilled.

The irrigation water use is presented in Figure 2. The 40 and 80 mm treatments used approximately 1.7 ML/ha less and the 160 mm treatment 2.5 ML/ha less irrigation water than the flooded treatment.

Crop growth

When all of the delayed flood treatments received permanent water in early January, the dry matter production from the delayed flood treatments (especially the 160 mm treatment) was significantly less than the flooded treatment. By panicle initiation the dry matter production of the 40 and 80 mm delayed flood treatments were not significantly different to the flooded treatment, but the flooded treatment has since received its panicle initiation nitrogen application. At anthesis there was no significant difference in dry matter between any of the treatments.

Where to now?

The delayed permanent water treatments have shown a reduction in water use compared with the conventional flooded treatment, but the benefit of this saving will not be known until grain yield is measured at the end of this rice season.

Once the experiment is complete, gross margin analysis will be used to determine if a financial benefit is gained from the delayed flood practice. The variables of grain yield, water use, weed control and nitrogen efficiency will be assessed. Modelling using long-term weather data, as well as future climate projections, will follow.

The intermittent flushing of rice leads to nitrogen loss in the form of nitrous oxide when the rice is reflooded. Nitrous oxide has 300 times the global warming potential of carbon dioxide (and methane 21 times). Research is needed to determine the most efficient times and splits for applying nitrogen in the intermittently irrigated system and the nitrogen treatment effects on greenhouse gas emissions.

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Further information

Brian Dunn
Research Agronomist
NSW DPI, Yanco Agricultural Institute
T: 02 6951 2621
E: brian.dunn@dpi.nsw.gov.au