Delayed permanent water (DPW) has proven to be a successful alternative water management practice for rice growing that provides considerable water savings and significant financial benefit.

The rice crop is sown and initially managed the same as a conventional drill sown crop but permanent water is not applied until late-tillering. The reduced time the crop is growing in ponded water results in lower water use, primarily due to reduced evaporative losses from the water surface, before the crop reaches full canopy cover.

**Water savings**

Four years of research on two soil types has demonstrated that delayed permanent water provides considerable water savings (Table 1). DPW can provide a 2.5 ML/ha water saving over conventional drill sown rice, while conventional drill uses 2 ML/ha less water than aerial sown rice.

Grain yield is sometimes slightly lower with DPW compared to conventional drill sown rice, but on average the water productivity of DPW is 15% higher than conventional drill sown rice (Table 1).

Table 1. Grain yield, water use and water productivity for different rice growing methods (based on four years research).

<table>
<thead>
<tr>
<th>Gross margin</th>
<th>Aerial sown</th>
<th>Drill sown</th>
<th>Drill with DPW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain yield (t/ha)</td>
<td>12.1</td>
<td>12.1</td>
<td>11.6</td>
</tr>
<tr>
<td>Irrigation water use (ML/ha)</td>
<td>14.9</td>
<td>12.9</td>
<td>10.4</td>
</tr>
<tr>
<td>Water productivity (t/ML)</td>
<td>0.8</td>
<td>0.9</td>
<td>1.1</td>
</tr>
</tbody>
</table>

Figure 1. Experiment comparing aerial, drill and DPW water management practices at Leeton in the 2017/18 season.

An experiment conducted at Leeton in 2017/18 compared aerial, drill and DPW rice (Figure 1). The results highlight that...
similar grain yields can be achieved by all sowing/management practices (Figure 2).

**Financial benefit**

There is considerable financial benefit from drill sowing rice and delaying permanent water. When the irrigation water saved from drill sowing and DPW was used to grow additional rice area, the total gross margin for DPW was 59% higher and conventional drill 30% higher, than the total gross margin for aerial sown rice.

Preliminary results also show that DPW can produce a higher whole grain yield than both aerial and drill sown rice. When these results are factored in the benefits of DPW are further increased.

**Irrigation layout and sowing**

Good irrigation layout is essential for successful establishment of drill sown rice. The layout must allow full surface water drainage within 24 hours of flooding, particularly after the first and second flush irrigations. Ponded water during establishment will result in a poor plant population.

Delaying permanent water on drill sown rice

The recommended sowing rate for DPW is the same as for conventional drill sown rice. Rice grown using DPW produces as many tillers as conventional drill and aerial sown rice. Higher sowing rates create a denser crop which requires more regular flush irrigations and therefore increased water use with no increase in yield.

Sowing should occur 7 to 10 days earlier for DPW than for conventional drill sown rice, as DPW will delay crop development (see the NSW DPI Rice Variety Guide). The more the crop is stressed between irrigations the greater the delay.

Do not delay permanent water when growing the short season varieties Viand and YRK5 if sowing later than the recommended sowing window. It will slow crop development and increase the risk of a late harvest.

**Irrigation frequency**

To ensure good establishment, do not severely moisture stress rice before it reaches the two leaf stage.
Once the rice plants are established (Figure 3), increase the time between flush irrigations. The longer the period between irrigations the greater the water savings, but as moisture stress is increased, plant crop development is delayed.

The use of evapotranspiration (ETo) levels to schedule irrigation timing is a simple and effective way to determine when to irrigate. Irrigate at a cumulative ETo of between 80 and 100 mm, depending on soil type, with crop coefficients of 0.6 and 0.8 for early and late November respectively and 1.0 for December. Daily ETref_t (mm) for Griffith, Hay, Finley and Tullakool can be found here. [http://weather.csiro.au/](http://weather.csiro.au/)

Using ETto to manage irrigation timing also allows a good level of planning.

Alternatively, flush irrigate the crop once it starts to show visible signs of moisture stress in the thicker parts of the crop i.e. corners or sowing overlap areas. The use of this method requires access to irrigation water at short notice.

**When to apply permanent water**

The later permanent water is applied the greater the water savings. Permanent water must be applied no later than 10 to 14 days before panicle initiation (PI) in order to avoid moisture stress implications during the reproductive period. It is wise to apply permanent water prior to Christmas, before any potential water supply difficulties may occur, due to high irrigation water demand.

Permanent water can be applied earlier if required due to pressure from high weed populations.

**Nitrogen Management**

It is important to sow a starter fertiliser with the seed when drill sowing rice. The seed requires phosphorus during establishment and even though the nitrogen doesn’t increase yield, it often improves early growth.

Large nitrogen losses occur if nitrogen is applied at sowing or between the flush irrigations. The best nitrogen option for DPW rice is to apply 200 to 250 kg/ha of urea onto dry soil prior to permanent water (Figure 4).

Research experiments have shown applying urea to the dry soil prior to permanent water provides the highest grain yield and best nitrogen use efficiency. This practice is very efficient with an average 72% apparent nitrogen recovery compared to 60% for conventional drill. Figure 2 shows the higher grain yield.
Delaying permanent water on drill sown rice achieved at lower nitrogen rates for DPW compared to drill and aerial sown rice.

When DPW has been practiced, sampling at panicle initiation (PI) for the PI Tissue Test will provide accurate results provided permanent water was applied not later than 14 days before sampling.

**Weed Control**

Effective grass weed management is critical to profitable DPW practice. Often the window for effective chemical application is small so weed presence and growth must be monitored regularly.

*Figure 5. Grass weeds can be a significant problem with DPW and must be controlled early.*

NSW DPI recommend spraying with a paraquat (Gramoxone®), pendimethalin (Stomp®), clomazone (Magister®) mix after the first flush and before any rice emerges. This provides a knockdown for already established weeds and some residual grass weed control.

See the NSW DPI Rice Crop Protection Guide for details on this and other chemical control options.

Aquatic weeds are often not a problem with DPW as the soil drying between flush irrigations controls them. Therefore spray drift of broadleaf herbicides onto sensitive crops such as cotton, soybeans or grapes is not an issue.

**Conclusion**

DPW provides good water savings, minimal yield reduction with high whole grain yield, high nitrogen use efficiency and aquatic weed control, making it a viable management option for drill sown rice.

**Acknowledgments**

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**More information**

NSW DPI Primefact 1253: Management of drill sown rice.

NSW DPI Primefact 1112: Rice variety guide 2018–19.

NSW DPI Rice crop protection guide 2018–19

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