Cold damage leaves nitrogen questions unanswered in 2004–05

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IN A RICE HULL

- It is difficult to make solid conclusions about 2004–05 trials on nitrogen fertiliser application timing, as the results may have been influenced by the extreme cold weather experienced during the first week of February 2005
- However, this season, treatments with split nitrogen application showed better yields than total pre-flood nitrogen applications
- In continuously flooded fields, a second nitrogen application at panicle initiation showed better yields than a nitrogen application at mid-season
- In fields drained at mid-season, a second application of nitrogen fertiliser just before re-flooding showed better responses than application at panicle initiation

The best time to apply nitrogen fertiliser to rice crops remains a difficult question to answer. Past research shows benefits with several different strategies, and new practices by growers and new opportunities for nitrogen application with mid-season drainage provide more situations that require investigation.

Research into the effect of the timing of nitrogen fertiliser application on yield has been ongoing for many years. Some findings have shown that total application of nitrogen fertiliser before flooding improves yield as well as nitrogen fertiliser efficiency. Other findings have demonstrated that heavy total applications before flooding can increase the risk of damage to the crop in cold seasons, and induce lodging at harvest.

Research into nitrogen fertiliser application timing continues, so fertiliser recommendations for rice growers can be consolidated, and so that recommendations encompass changes in practices and conditions.

Of recent years, some rice growers have been applying nitrogen during the mid-tillering stage, with applications determined by the appearance of the crop. Some investigations have revealed that application of nitrogen fertiliser into open water with little plant canopy during mid-tillering can incur heavy nitrogen losses.

Another factor to be considered in terms of opportunities for nitrogen application is at the end of mid-season drainage. Mid-season drainage is being practised, to the greatest degree in the Western Murray Valley to reduce straighthead disorder. Yields are being increased by 0.5–1.0 t/ha due to this practice, however the reasons for these benefits are yet to be ascertained. In the trial work conducted this season, there was the opportunity to investigate nitrogen fertiliser application just before re-flooding the bays, after mid-season drainage. Assuming nitrogen fertiliser enters cracks in the soil developed during dry down, application of nitrogen fertiliser at this stage can be carried out without much nitrogen loss. However, mid-season drainage is a difficult practice and it is important to find other management strategies to reduce the straighthead occurrence in rice.

2004–05 field trials

During the 2004–05 rice season, three trials were carried out at Jerilderie and Wakool. Two investigated a range of nitrogen fertiliser timing strategies, and a third looked at the interactions of a range of nutrients and drainage strategies associated with the occurrence of straighthead.

Four levels of nitrogen (0, 90, 180 and 270 kg N/ha) were applied to an Amaroo crop at Jerilderie, with four different timing strategies:

1. total nitrogen at pre-flood
2. 2/3 at pre-flood and 1/3 at panicle initiation
3. 2/3 at pre-flood and 1/3 at mid-season
4. 1/3 at pre-flood, 1/3 at mid-season and 1/3 at panicle initiation

At Wakool, where mid-season drainage was practiced, four levels of nitrogen (0, 90, 180 and 270 kg N/ha) were applied to an Opus crop, using the following timing strategies:

1. total nitrogen at pre-flood
2. 2/3 at pre-flood and 1/3 just before re-flooding after mid-season drainage
3. 1/3 at pre-flood and 2/3 just before re-flooding after mid-season drainage
4. 2/3 at pre-flood and 1/3 at panicle initiation

The third experiment, also at Wakool, consisted of 11 treatments of different levels and combinations of nitrogen, sulphur, zinc and copper, and two water management practices (continuous flooding and mid-season drainage), to investigate the effect of these treatments on straighthead occurrence. Foliar treatments were carried out during mid-tillering. Cold damage on this crop meant there was no detectable straighthead last season, and the impacts of the treatments were unable to be measured.

Yield response to nitrogen

There was marked variation in response to nitrogen among treatments at both sites.

Jerilderie trial

At Jerilderie, all treatments with split nitrogen application showed continuous yield increase with an increase in nitrogen fertiliser rate (Figure 1), with the exception of the treatment with total nitrogen applied pre-flood, which showed a significant yield decline after the 90 kg N/ha rate.

The split nitrogen application with 2/3 total nitrogen at pre-flood and 1/3 at panicle initiation resulted in higher grain yield compared with the other three treatments, except at 270 kg/ha rate. At 270 kg/ha rate, the treatment with three equal nitrogen splits gave the highest yield.

The split nitrogen application with 2/3 total nitrogen at pre-flood and 1/3 at mid-season gave lower yield compared to the split nitrogen treatment with the second nitrogen application at panicle initiation, at each nitrogen rate, suggesting that split nitrogen application at panicle initiation is better than split nitrogen application at mid-tillering.

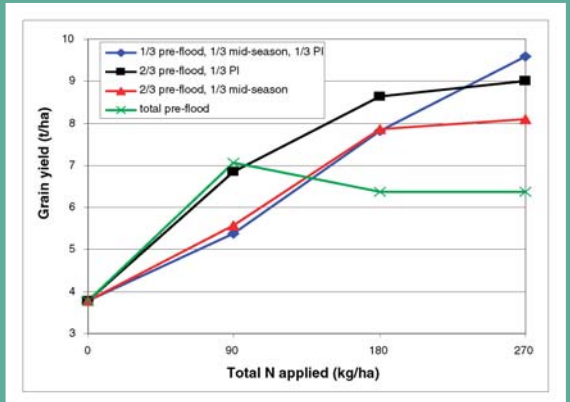

Figure 1 *Yield response to rate and timing of nitrogen application at Jerilderie*

Earlier investigations also showed that top dressing at mid-tillering is less efficient than top dressing at panicle initiation. The cause of this is most likely due to the roots not being sufficiently developed to rapidly and fully utilise fertiliser nitrogen at mid-tillering, and unused nitrogen applied to open-floodwater may be lost due to denitrification. However, if an inadequate amount of pre-flood nitrogen is applied, if pre-flood nitrogen is not managed correctly, or if the soil is inherently low in fertility, an application of nitrogen at mid-tillering may be beneficial. While visual observations have been used in the past to decide about a mid-tillering nitrogen application, investigations should be carried out to quantify the nitrogen requirement at that stage, based on plant biomass and nitrogen uptake, using the NIR tissue test, as practiced at panicle initiation.

Wakool trial

Nitrogen and low temperature interactions due to the extremely cold weather during the first week of February had an overriding effect on the trial at Wakool, where all the treatments showed continuous decline with increased nitrogen application.

The treatment with total nitrogen application at pre-flood (no split) showed the lowest yield at each nitrogen level compared with the other three treatments with split nitrogen, similar to the results at the Jerilderie site.

The treatment with 1/3 nitrogen at pre-flood and 2/3 just before re-flooding after mid-season drainage showed higher yield than the treatment with 2/3 nitrogen at pre-flood and 1/3 just before re-flooding. Both treatments with split nitrogen application just prior to re-flooding (mid-season) gave higher yields at each nitrogen rate compared to the treatment with split nitrogen application at panicle initiation. This suggests that application of nitrogen fertiliser just before re-flooding after mid-season drainage is more beneficial than nitrogen application at panicle initiation. In addition, application of nitrogen just before re-flooding could minimise the losses as nitrogen may go into cracks created during the dry down. Therefore, these results lead to speculation that the efficiency of nitrogen application is high if applied just before re-flooding compared with nitrogen application at panicle initiation where mid-season drainage is practiced.

Further research needs to be carried out on this concept before reaching a conclusion.

Yield response to mid-season draining and other nutrients

There were no significant yield differences between the control and the 10 treatments involving nutrients other than nitrogen (Figure 2). However, the treatment with 200 kg N/ha gave the lowest yield. This may be attributed to the nitrogen and low temperature interactions due to the extremely cold weather during the first week of February.

The results also showed that there is a small yield advantage from mid-season drainage compared with continuously flooding. This yield advantage in mid-season drainage could be due to increased availability of certain nutrients resulting from the oxidation of the rhizosphere during the dry

down. Results of flag leaf analysis (Table 1) at anthesis support this hypothesis as mid-season drainage showed increased leaf potassium, magnesium, manganese and copper content compared with that of continuous flooding.

There was no sign of straighthead in the 2004–05 season at this site, therefore no conclusions can be drawn about the effect of these nutrients and water management on reducing the impact of straighthead.

Table 1
Effect of mid-season drainage on the nutrient content of the flag leaf, compared with the nutrient content of the flag leaf in treatment with continuous flooding

Element	Effect of drainage
Sulphur	Reduced 3%
Zinc	No effect
Copper	Increased 23%
Calcium	Reduced 20%
Chloride	Increased 10%
Iron	Reduced 8%
Potassium	Increased 7%
Magnesium	Increased 12%
Manganese	Increased 17%
Sodium	Increased 15%
Phosphorus	No effect
Silicon	No effect

Conclusions

It is difficult to make solid conclusions as the results may have been influenced by the extremely cold weather experienced during the first week of February 2005. However, the following provisional conclusions could be made until further investigations are carried out.

- Split nitrogen application showed better responses than total pre-flood nitrogen applications (no split).
- Splitting application at panicle initiation is better than at mid-season in continuously flooded fields.
- Application of nitrogen fertiliser just before re-flooding in bays with mid-season drainage showed better responses than applications at panicle initiation.
- The yield advantage from mid-season drainage may be due to increased availability of certain nutrients.

RIRDC Project DAN-207A

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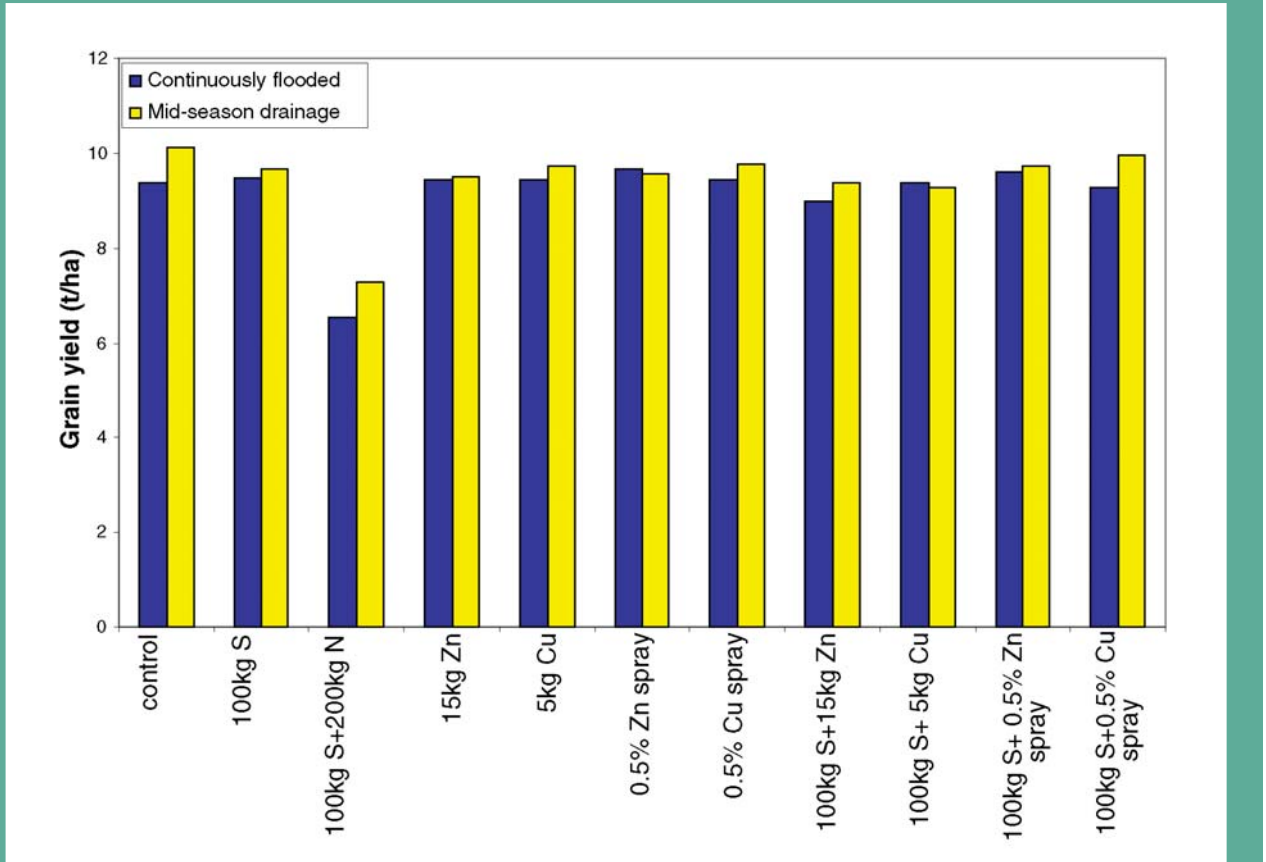

Figure 2 *Yield response to different nutrients under different water regimes*