



Nitrogen for rice

– get the basics right for high yields & profit

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- For efficient use of nitrogen and to achieve a high yield potential, apply sufficient nitrogen prior to permanent water to reach a panicle initiation (PI) nitrogen uptake of 140–150 kg N/ha in the MIA and CIA, and 120–130 kg N/ha in the Murray Valley.
- Fields with no recent history of legumes require a minimum of 90 kg N/ha (200 kg/ha urea) applied prior to permanent water to achieve the target PI nitrogen uptake (for fields in the MIA and CIA).
- Avoid applying urea into a flooded field when the rice plants are small, as this is very inefficient. Unless the crop is severely under-fertilised apply additional nitrogen if required at panicle initiation based on NIR tissue test recommendations.
- Recently landformed fields, that have not been topsoiled, require extra nitrogen and phosphorus to be applied to the cut areas prior to permanent water.

Nitrogen is a critical element in profitable rice production. Too little nitrogen results in low yield and profit while too much can lead to lodging, high levels of sterility and reduced yield.

Many farmers have not grown rice for a few years so we thought it would be a good time to have a refresher of rice nitrogen and associated issues.

Nitrogen timing

The most efficient time to apply nitrogen (urea) is either drilled 10 cm deep into the soil up to one week prior to permanent water for aerial sown crops, or spread onto a dry soil surface just prior to permanent water at the 3-leaf stage of a drill sown crop. The soil surface (2–3 cm) must be dry so that when the urea dissolves, as permanent water is applied, it washes directly into the soil. Urea applied to a moist soil surface can be lost as nitrogen gas when it dissolves in the moisture.

By far the worst (most inefficient) time to apply nitrogen is into the flooded bays when the rice plants are small. There are no roots to capture the nitrogen and most of it will volatilise (ie be lost to the atmosphere). When we apply nitrogen at panicle initiation (PI) it is more efficient than application into the water early because the crop has developed a thick canopy which slows down the speed at which the nitrogen volatilises. Also lots of surface roots have developed which can quickly take up the nitrogen before it is lost.

If we had a soil nitrogen test that could accurately predict the crop's nitrogen requirements we would apply all the nitrogen before permanent water, but we don't, so we use field history to determine how much to apply at that stage. We then top up at panicle initiation using recommendations from the NIR tissue

test which are based on the crop's growth and nitrogen content, and many years of experimental data.

Nitrogen (& phosphorus) at sowing

Farmers often apply a starter fertiliser (a nitrogen-phosphorus mix) with the seed when drill sowing rice as it appears to improve early crop growth and vigour but often does not lead to increased grain yield. Much of the nitrogen in the starter fertiliser applied at sowing is lost during the flush irrigations due to denitrification. Nitrogen in starter fertiliser is often an expensive form of nitrogen.

In fields with low levels of soil phosphorus (Colwell P less than 30 mg/kg), it is recommended to apply single or double superphosphate with the seed when drill sowing. Do not spread fertilisers containing phosphorus on the soil surface before permanent water when aerial or drill sowing, as it encourages algal growth.

Pre-permanent water nitrogen rates

When aiming for high rice yields (eg 12 t/ha) you need to apply sufficient nitrogen before permanent water to reach a target PI nitrogen uptake of between 140–150 kg N/ha for crops in the MIA and CIA. In the Murray Valley the target should be 120–130 kg N/ha because of the higher cold risk. These recommendations are for the main semi-dwarf varieties, not for Koshihikari, Kyeema and Doongara, which should receive lower rates of nitrogen.

In recent years, due to the drought and low irrigation water availability there has been very little legume pasture grown and soil nitrogen (ammonium) levels are generally low. PI nitrogen uptake results from district rice experiments conducted between 2006 and 2010 show the relationship between levels

of nitrogen applied prior to permanent water and PI nitrogen uptake (Figure 1). This data is from 495 sites in 15 fields located in the MIA and CIA which have not recently grown legumes or had manure applications. The graph shows the range of PI nitrogen uptakes achieved at a range of pre-permanent water nitrogen rates. A top boundary line is drawn across the maximum nitrogen uptakes achieved from the sites at a range of nitrogen rates.

For fields with no recent history of legume pasture or manure applications, growing semi-dwarf varieties, sown at the correct time, apply a **minimum of 90 kg N/ha (200 kg/ha urea)** either into the soil before permanent water for aerial sown crops or onto dry soil before permanent water for drill sown crops. This recommendation is for fields in the MIA and CIA areas and may be increased depending on cropping history in the field, fertiliser history, water depth obtainable at microspore, variety grown and the individual farmer's aversion to risk. On average, 130 kg N/ha (280 kg/ha urea) applied before permanent water is necessary to reach the minimum PI nitrogen uptake target (120 kg N/ha).

Landformed fields

In fields that have recently been landformed (less than 10 years), the cut areas will often require higher levels of nitrogen and phosphorus to be applied prior to permanent water. How much extra, and for how long it will need to be applied, depends on the depth of cut and the depth of topsoil prior to landforming. For freshly cut areas less than 10 cm in depth an extra 60–90 kg N/ha (130–200 kg/ha urea) applied prior to permanent water may be needed.

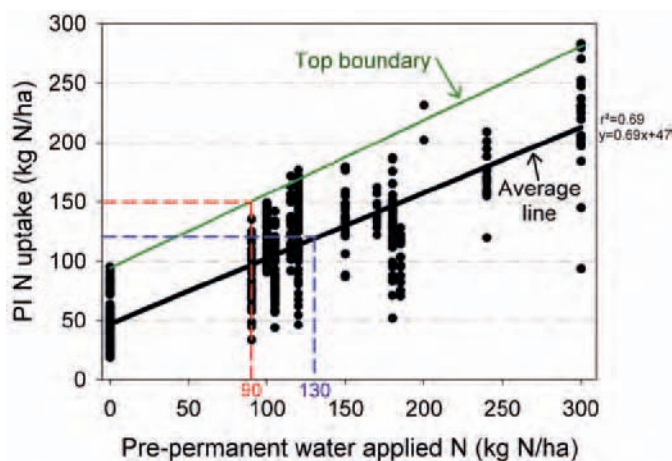


Figure 1. PI nitrogen uptake for a range of pre-permanent water applied nitrogen rates from experiments conducted in fields with no recent history of legume pasture and growing semi-dwarf varieties. On average, 130 kg N/ha applied pre-permanent water is necessary to reach the minimum PI nitrogen uptake target (120 kg N/ha).

Recent research has shown that in many soil types applying extra nitrogen to deep cut soils, without sufficient phosphorus being available, will not increase grain yield. Heavy cut areas have very low levels of phosphorus as most of the phosphorus was in the topsoil that has been removed. These soils also have a higher soil pH which limits phosphorus availability to the rice plant when the field is flooded. We suggest that for cuts greater than 10 cm, apply extra phosphorus each year for up to five years. In some cases an extra 30 kg/ha of phosphorus is needed to achieve a high yield potential. For deeper cuts apply higher rates of phosphorus and for a longer period of time.



Applying urea to the dry soil surface prior to applying permanent water is a very efficient nitrogen practice for drill sown rice. The applied water will dissolve the urea and wash it into the soil where the nitrogen fixes to the clay particles.

Mid-season applied nitrogen

Applying mid-season nitrogen (during tillering) is inefficient and should only be considered when crop growth is extremely poor. If the crop is not expected to reach 80 kg/ha nitrogen uptake by panicle initiation, it may be necessary to apply mid-season nitrogen, otherwise yield potential will be reduced. Applying nitrogen after mid December may result in inaccurate NIR tissue test recommendations when sampling at panicle initiation.

Sow on time & deep water after PI

To consistently achieve high grain yields often means applying higher rates of nitrogen which may increase the risk of cold damage. Therefore nitrogen management must also take into account and be in conjunction with practices that reduce the risk of cold induced sterility.

The recommended sowing time for each variety is based on the crop reaching pollen microspore (the most sensitive time for cold damage) between the last 10 days of January and first 10 days of February when temperatures are most favourable and the risk of low (less than 17°C) night temperatures is least. Microspore normally occurs about two weeks after panicle initiation.

Deep water (20–25 cm above the soil surface) will help protect the developing panicle from the sterility effects caused by low temperatures during microspore. Apply deep water after panicle initiation and maintain until the crop starts to flower (25% of panicles visible). The deep water doesn't get as cold as the air during the early morning before the day starts to warm up again (Figure 2).

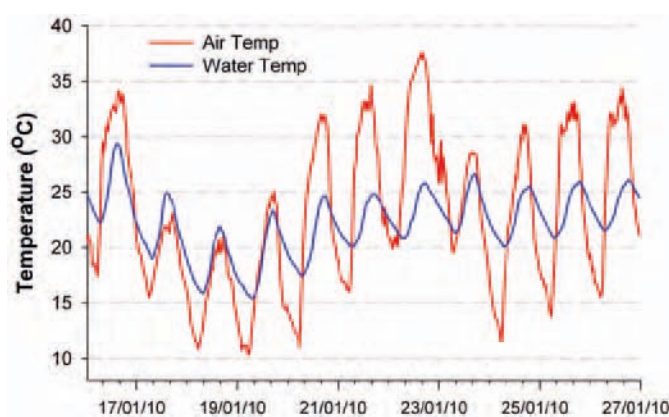


Figure 2. Air (red) and water (blue) temperatures measured in rice during January. The water temperature does not drop as low as the air temperature, therefore the water helps to protect the developing pollen from cold temperatures during microspore.

Summary

Good nitrogen management is crucial for achieving high rice yields and profitability. Combined with sowing on time and applying deep water after panicle initiation, the correct timing and rate of nitrogen application can lead to consistently high rice grain yields. 🌞

Further information

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Incorporating nitrogen into the soil prior to application of permanent water is the most efficient way to apply nitrogen when rice is aerial sown.