Fertiliser Rates in Maize

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Key Learnings

Any conclusions about the merits of reducing or increasing fertiliser use in maize based on the grower demonstration are handicapped by the lack of replication and the results can be influenced by site variability or transport of N via irrigation water between the strips.

The results from this focus paddock align with the results seen in the 12 nitrogen trials conducted as part of the Optimising Irrigated Grains research which found applied N rates above 240 kg N/ha saw no yield response.

During the growing season the Irrigation Discussion Group visited the focus paddock to discuss the Optimising Irrigated Grains maize trial results and the sources of N available to the crop including soil N present at sowing and in-crop mineralisation.

Growers attending the day were applying N at rates varying from 320 to nearly 600kg N/ha. Most growers were not soil testing, relying on a strategy of high inputs ensuring crop demand throughout the season is met. Although most admitted they were probably leaving N behind, the assumption was that this would be utilised by the next crop. The discussion highlighted the need for greater soil testing so decisions could be made on evidence rather than gutfeel. Soil testing is a relatively low cost when weighed against overspend on fertiliser. The results from this demonstration showed that the host could have potentially saved $170/ha in input costs.

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The demonstration surprised the focus paddock host, who had expected to see yield difference, the lack of yield increases suggests that standard N application rates may be excessive. The paddock utilised was a long-term corn paddock, where stubble had been retained. The OIG project results suggested that an 18-19t/ha maize crop contains about 400kg N/ha of which 100 – 160 kg N/ha was supplied by the soil N and in-crop mineralisation and therefore applied N rates above 240 kg N/ha saw no yield response.

But, if the crop was grown under different circumstances – poor soil N levels, little crop residue for mineralisation or poor irrigation infrastructure that resulted in waterlogging and de-nitrification – then a grower within this situation may have to apply higher rates of N than the OIG project found.

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Focus Paddock Summary

The findings from the GRDC funded Optimising Irrigated Grains project highlighted the important role of soil nitrogen supply and in-crop mineralisation, and found that in a fertile farming system that traditional fertiliser rates were higher than what the crop could take up during the growing season.

Maize grain is a high value commodity, so growers invest in maximising yield potential. Growers and advisors raised concerns that dropping fertiliser rates might mean reducing yield potential or mean there wouldn't be enough N in front of the plant at key growth stages and at peak growth rates. Many deemed the risk of lost income because of a yield penalty to be greater than the risk of overspending on fertiliser, even when fertiliser prices peaked in 2022. The Irrigation Farmers Network (IFN) Irrigation Discussion Group's focus paddock tested the rates of nitrogen (N) being applied to an irrigated maize crop, timing of N applied and included a high phosphorus (P) treatment in large scale in-paddock strips.

Harvest yields were similar across all treatments, suggesting N rates could potentially be reduced, especially when the soil's ability to supply N and mineralisation of previous crop residues are factored into the N budget of the crop. The standard application rate of P seems to be meeting crop requirements.

The demonstration was set up by a long-term maize grower that wanted to test the rates of N he was using, the method of application and testing if higher rates of P fertiliser were warranted.

Background and Aims

The Optimising Irrigated Grains project found that there was little grain yield response to nitrogen (N) at rates higher than 240kg N/ha over three years of trials at two sites in Northern Victoria.

When presented to maize growers, these results are regarded with a large degree of skepticism as this rate is well below the rates commonly used by irrigated maize growers. However, when asked on how they arrive at the rates they use, there is little information on the kg N/t required by maize, little soil testing to determine soil fertility (in particular soil N at sowing) and in many cases, the potential of soil N to supply some of the crop's demand is ignored in favor of high rates of N applied to the crop.

Focus Paddock Details

Location: Yalca Victoria
Crop Type: Maize
Irrigation System: Surface Border Check

The treatments were instigated by the co-operator to test his standard practice (Treatment 1), reduced pre-plant N (Treatment 2), standard N rate plus extra pre-plant P (treatment 3) and reduced pre-plant N and extra N at sowing but overall reduced N rate (Treatment 4). The rest of the site was sown as per Treatment 1.

Table 1: Treatment summary. All rates are kg/ha.

Treatment	N pre plant	N @Sowing	N Post Plant	Total N kg N/ha	P Pre Plant
1 Standard	186	80	98	364	66
2 Low N	94	80	98	272	66
3 High P	196	80	98	374	88
4 No Upfront N	30	152	98	280	66

Soil tests were taken prior to fertiliser application. No measurement suggested any deficiencies/toxicities of any element apart from low sulfur. This was addressed in post-plant N application by using UAS. Soil N to 60cm was 65.5kg N/ha.

The trial plan consisted of bay length runs/strips of a 6-row maize planter (380m long x 4.5m wide) sown to maize on October 31 targeting 90,000 plants/ha. Treatment 1 was sown as four strips, Treatments 2 and 3 twice and Treatment 4 as one strip.

NDVI was assessed on November 28 when the crop was approximately 400mm high using a hand-held Trimble Greenseeker, at 4 10m portions of crop starting approximately 100m from the bottom of the bay.

The crop was harvested on April 4. A portable weighbin was used to calibrate the on-board yield monitor prior to harvest. Grain yields were recorded for each treatment strip and averaged where there was more than one measurement for that treatment.

Agronomic results

As this was a demonstration consisting of large treatment strips and limited replication, the results should be viewed with caution as there is the potential for some of the N applied to be carried by the irrigation water between treatments.

Table 2: NDVI and grain yield summary

	Summary	NDVI	Yield t/ha
1	Standard N&P	0.54	18.1
2	Low N	0.62	18.1
3	High P	0.55	18.4
4	No N upfront	0.53	17.2

NDVI measurements suggested the 'Low N' treatment had the greater canopy development as of November 28.

Yields were very similar across all treatments, and without replication, it is difficult to attribute any differences to the treatments. The yields achieved by the demonstration and surrounding paddock would be regarded as above average for the district.

Economic Results

Assuming the first three treatments yields were essentially the same, then the addition (or subtraction) of N and P had little effect on yield.

The difference between the N rates of treatments 1 and 2 was 94kg N/ha or $170/ha assuming urea was $850/t. Therefore the 'Low N' treatment saved the grower $170/ha.

If the yield increase of 0.3t/ha could be attributed to the extra P (and it is a large assumption to make given the lack of replication), then the extra 100kg/ha of MAP cost $140/ha for an increase of $90/ha from the extra yield.

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