

MORE PROFIT FROM NITROGEN



Matching nitrogen (N) plant demand using Enhanced Efficiency Fertilisers (EEFs) and implications for N field run-off in irrigated cotton – *An economic case study.*

About the research

The More Profit from Nitrogen Program (MPfN Program) is a cross-sector partnership between Australia's four intensive agricultural users of N fertilisers, formed to undertake research into improving nitrogen use efficiency (NUE). As part of the collaborative research, NSW Department of Primary Industries (NSW DPI), in partnership with CSIRO and the Cotton Research and Development Corporation (CRDC), conducted field trials at multiple research and commercial sites in New South Wales.

The research sought to understand how N can be managed most effectively to maximise productivity and quality, minimise losses to the environment and provide economic benefits to the producer.

Analysis of farm level economic benefits

Numerous studies in other industries have been undertaken on EEF products, often finding little yield benefit or improvement in nitrogen fertiliser use efficiency. The rationale for the research was to improve the synchronisation of release of plant available N from EEF products with crop N demand, thereby reducing N losses and consequently improving lint yield and fertiliser NUE. Granular urea was compared to urea coated with DMPP (nitrification inhibitor) in 2016–17 and 2017–18, and with polymer coated urea (PCU) in 2017–18 season. All N products were applied pre-season to fertile Black Vertosol soils. There was no significant difference in measured cotton lint yields between EEFs and urea (Figure 1), but this may not occur on other soil types.

KEY MESSAGES

- Measured over two seasons, the research found no significant differences in the measured cotton yield between Enhanced Efficiency Fertilisers (EEFs) and urea.
- There was no significant effect of EEFs on cotton plant physiology, including plant N uptake, compared to urea.
- The use of polymer coated urea (PCU) reduced lost N in irrigation water by up to half that in the urea treatment, with most losses occurring in the first two irrigations.
- Using *myBMP* to guide N application rates decreases the risk of environmental losses of excess N and saves on fertiliser wastage.

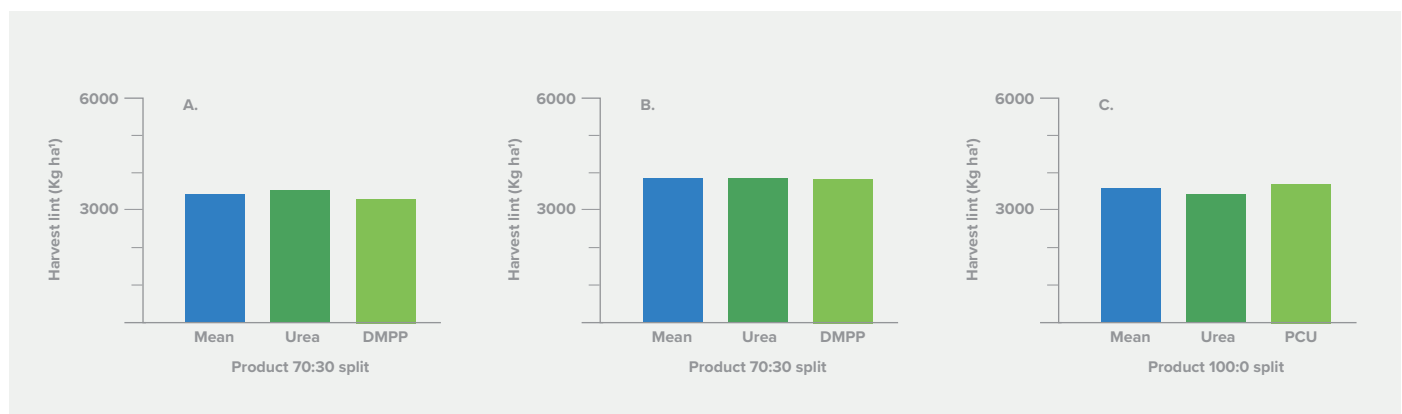


Figure 1. Cotton lint yield (kg/ha) measured by mechanical harvest for the enhanced efficiency fertilisers (A: 2016–17, B and C: 2017–18). Apparent treatment differences were not statistically significant.

¹ <https://www.publish.csiro.au/sr/sr07197>



Although there was no significant difference in the measured cotton yield or physiological properties (i.e. dry matter yield, biomass seed N & biomass seed) between the EEFs and urea, the potential impact of products on N losses during irrigation should also be considered.

Using a partial budget approach, the study valued the per hectare losses of N products, assuming a combined product/application cost of \$1.50 per kg/N for urea and \$3.75 per kg/N for PCU². The study³ found the highest proportion of N losses in runoff occurred in all pre-plant (24%) and 70:30 (pre-plant: in-crop) urea (22%), generally early in the irrigation season. Those treatments with the lowest N losses from run-off used pre-plant PCU-urea (7%). It should be noted, that while losses of PCU-urea were lower than pre-plant urea, this slow-release form allows for “safer” all upfront application than standard urea. PCU also reduces the risk of not being able to conduct in-crop applications if the season gets very wet. Seasonal total N runoff losses from the urea 100:0 and PCU 100:0 treatments were statistically different (Figure 2). A summary of products, timing, N rates and losses from irrigation run-off are summarised in Table 1.

Table 1 — Partial Gross Margin budget showing three separate treatments: upfront and split in-crop N applications and associated cost of N product losses through irrigation runoff.

N rate (kg/ha)	N-timing (pre: in-crop)	Pre-crop N form	In-crop N form	In-crop method	Total N Loss (NH ₄ +NO ₃) % applied	N Product Losses (\$/ha)
112	100:0	Urea	N/A	N/A	24%	\$40.32
112	70:30	Urea	Urea	Broadcast	21.7%	\$36.46
112	30:70	Urea	Ammonia, N26 or UAN	Water-run	17.8%	\$29.90
292	70:30	Urea	Urea	Broadcast	17.2%	\$75.34
112	100:0	PCU-Urea	N/A	N/A	6.7%	\$28.15
112	0:100	N/A	Urea	Broadcast	2.8%	\$1.57

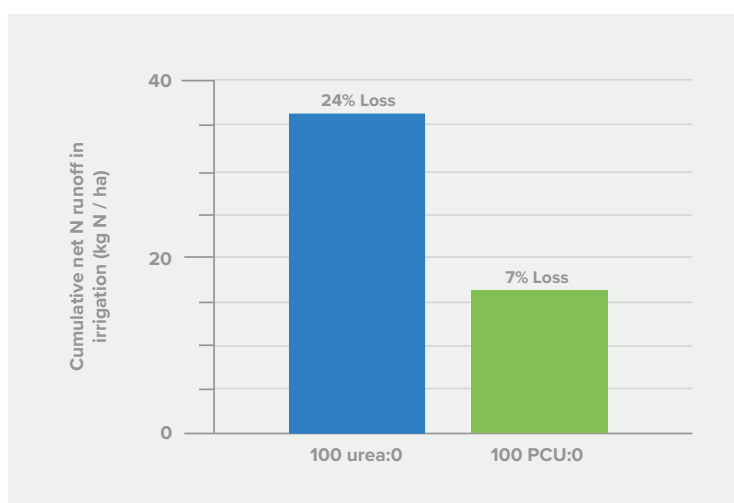


Figure 2. Cumulative net N runoff in irrigation (kg N/ha) in the 2017–18 season

ENHANCED EFFICIENCY FERTILISERS AND N LOSSES

EEF products led to higher post-harvest residual soil mineral N and reduced runoff losses. However, EEF benefit was limited to mitigating N losses rather than increased supply of N to the crop as N rates used were in excess of crop need.

To be economically justified, the EEF needs to be applied at a reduced N rate. EEFs also reduce greenhouse gas emissions occurring as nitrous oxide due to denitrification, an environmental cost which has not been quantified in this analysis.

²<http://www.kingenta.com.au/team/>

³https://www.soilscienceaustralia.org.au/wp-content/uploads/2019/10/Proceedings-Natl.-Soil-Sci-Conf-Canberra-18-23-Nov-2018-FINAL_reduced-size-1.pdf

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Applying fertiliser to the MPfN experimental plots at ACRI, Narrabri, 2018



Drone image of the 2018-19 experimental paddock at ACRI



The polymer capsules retained some of the applied N at the end of the 2017-18 season at ACRI



Sampling irrigation water to determine N runoff loss from the ACRI experimental plots, 2019-20 season



**FURTHER
INFORMATION**

FOR FURTHER INFORMATION ON THE MPfN PROGRAM:

Enhancing nutrient use efficiency in cotton project, contact the project leader:

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Visit www.crdc.com.au/more-profit-nitrogen

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