Irrigation Research & Extension Committee

2025 Demonstration Report

Nitrogen Fertiliser Effects on Irrigated Soybeans and Subsequent Wheat Crop

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Location: NSW Zone 5 — Coleambally | **Lead Institution:** CSU / SNSW Hub

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Demonstration summary

This demonstration was established at Coleambally as part of the GRDC nationally funded RiskWi$e project, to investigate the effect of both Green Urea NV® and urea on the nodulation, growth and yield of soybeans under irrigation and the impact on grain quality and yield of the following cereal crop. The demonstration also aimed to determine nitrogen effects on irrigated soybeans and the following crop, and to determine the mineralisation effects of residual N in the following fallow.

Soybeans were grown in a replicated trial with nil control, Green Urea NV® and urea treatments. Nodulation, biomass and grain yield were assessed, and deep soil nitrogen testing was used to determine whether there were any legacy effects in the following wheat crop and fallow.

Results showed that the soybeans were unresponsive to nitrogen fertiliser, with no difference shown between treatments for biomass or grain yield. Differences in nodulation were observed, where urea appeared to reduce nodulation, while the Green Urea NV® treatments were more variable. Deep soil nitrogen testing and monitoring of the following wheat crop also showed no legacy effect from applying different amounts of nitrogen. Overall, the trial results showed that applying N fertiliser was not justified under these conditions, as there was no agronomic or economic benefit.

Background & aims

To investigate the effect of both Green Urea NV® and urea on the nodulation, growth and yield of soybeans under irrigation and the impact on grain quality and yield of the following cereal crop. It also aimed to determine nitrogen effects on irrigated soybeans and the following crop. Also to determine the mineralisation effects of residual N in the following fallow.

Trial duration

September 2023 – 2025

Demonstration details

Soybeans were grown in 1.8m beds in a bank less channel layout, with the bed used as a plot width. The plot length was 10 metres. The trial had 4 replicates in a randomised complete block design with the following treatments:

Table 1. Fertiliser treatments and application rates

Treatment	Fertiliser Type	Rate
Control	No nitrogen applied	0
Treatment 1	Green Urea NV®	Low
Treatment 2	Green Urea NV®	Medium
Treatment 3	Green Urea NV®	High
Treatment 4	Urea	Low
Treatment 5	Urea	Medium
Treatment 6	Urea	High

Soil cores collected during deep soil nitrogen sampling at the demonstration site.

Assessing soybean nodulation during the demonstration.

Soil sampling dates

- 12/01/2024
- 7/5/2024
- 17/07/2025

Nitrogen rates

- 25 kg N/ha
- 46 kg N/ha
- 100 kg N/ha

Environmental impacts, crop inputs and/or pesticide applications

The site was well managed by the host grower with grass herbicides applied during early growth and regular irrigation during critical growth periods.

Seasonal conditions

There were very mild temperatures during the growing season which meant that soil moisture could be managed effectively with irrigation. There were no cold or hot periods during critical growth periods that should have impacted the crop or any of the treatments.

Table 2. Crop type/rotation.

Year	Crop
2023	Soybeans
2024	Wheat
2025	Fallow

Table 3. Crop details.

Field	Details
Cultivar	Durum wheat
Sowing date	Soybeans - Sep 2023, Wheat - April 2024
Top-dressing date(s)	12/01/2024
Harvest date	1/05/2024
Basal fertiliser inputs	Nil

Methodology

The trial plots were GPS referenced to enable further trial work in subsequent seasons. Deep N tests and local agronomic advice will be used to determine the exact fertiliser rates used for the low, medium and high-rate treatments. The urea would be applied approximately 14 days after emergence as a top-dressed fertiliser (hand-spread across each plot).

Approximately 8-10 weeks after sowing, each plot will be nodule scored to determine if there is a treatment difference in the nodulation of the soybeans following the fertiliser application. This is completed by digging a 1m row of plants and assessing the nodulation using a scoring guide.

Biomass cuts will be taken once the soybean crop reaches late flowering/early pod fill growth stage. In each plot a 0.5 square metre cut is taken and the sample is then dried and weighed to determine the dry matter for each treatment.

At maturity, harvest index cuts will be taken determine grain yield and harvest index. A 0.5 square metre cut is taken and the sample will be dried. The sample is than threshed to remove the grain. Harvest index is calculated as total grain weight x total dry matter weight.

Soil sampling would be taken prior to the following crop being sown. Each plot will be sampled for mineral N to a depth of 60cm. A wheat crop was planted immediately following the soybeans and this crop was monitored to see if there is any legacy effect of the treatments.

In the 2025 fallow, we deep N soil sampled (0-10cm, 10-30cm, 30-60cm) to see if there was any mineralisation of N after a rain event.

Agronomic results

Crop responses in this season

The addition of fertiliser did not appear to have a significant effect on biomass, however, there appeared to be differences in nodulation (Figure 1). Applying fertiliser may cause legumes to become 'lazy' and reduce N fixation because there already is a supply of N to the crop. The results show that this may have occurred where urea was applied, however the Green Urea NV® treatments were more variable and because of the slow release of N to the crop, nodulation may not have been as affected.

Harvest Index cuts were taken to determine the grain yield, however, as with the biomass cuts, no difference was shown between treatments. This means that the soybeans were unresponsive to the nitrogen fertiliser applied. The soybeans averaged 3.2T/ha with no significant difference between treatments.

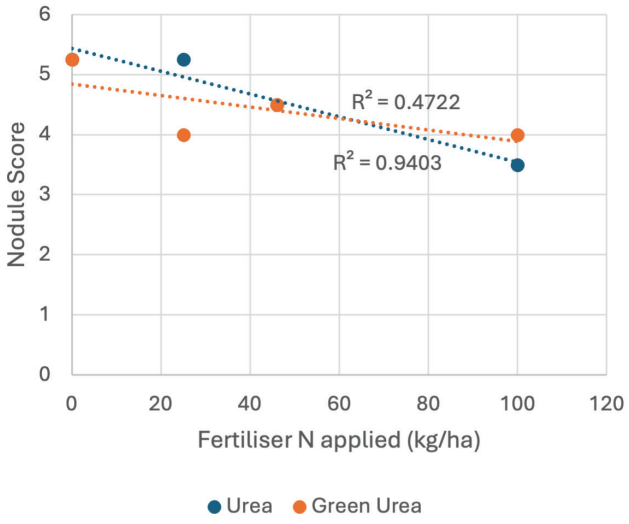

Figure 1. Nodule scoring on all treatments where a lower nodulation was observed with an increasing amount of N fertiliser.

The deep soil nitrogen that were taken after harvest and before a winter cereal was sown, also showed no difference between treatments. The test results had an average of 44kg/ha N in the 0-60cm test and there was no correlation to nitrogen rate applied. The wheat crop following the soybeans will be monitored however, these results show that there may be no legacy effect from the soybean crop treatments noticeable. As the crop was unresponsive to N fertiliser, the benefit of using green urea was also not observed and using a different crop type may be needed to determine the effectiveness of using the different fertiliser options.

As predicted there was no impact on the following wheat crop grown which showed consistent yield and protein across the treatments measured. The trial results give the confidence that applying N fertiliser is not going to have any effect on crop yield even when an enhanced efficiency product is used. Therefore the risk associated with applying fertiliser is not justified.

Soybean crop at maturity prior to harvest at the demonstration site.

Having monitored the following wheat crop for legacy effects, it was determined from soil samples, protein testing and yield there were no legacy effects from applying different amounts of nitrogen on soybeans.

In the 2025 fallow following wheat, we wanted to reinforce that N is banked and wanted to see how N is mineralized after a rainfall event. Deep N soil tests were conducted and compared to the previous soil tests taken in May 2024. In 2024 the average deep soil N results were 43.8kg/ha of N, whilst the soil tests in 2025 were 45kg/ha of N. Even though this is a small increase, it does show N being banked for over a year and a small amount of mineralisation.

Economic results

As there was no crop response to the fertiliser applications, there was also no economic gain from applying fertiliser. Therefore, any additional cost from applying the fertiliser would only result in a decrease in profitability.

There was a chance that the Green Urea NV product may result in more soil mineral N available to the subsequent wheat crop but this was not observed in the soil test results or the wheat grain yield and protein. The profitability of the wheat crop would benefit the most from just having a legume crop in the rotation where no additional fertiliser is needed and possibly reducing the fertiliser budget for subsequent crops through the legume plant fixating N.

Key learnings & recommendations

There were no unexpected findings and the trial proved that applying N fertiliser is not beneficial to an irrigated legume crop.

While the seasonal conditions observed could have been more favourable than most seasons, it is not expected that this had any implications on the results and the same result would be observed in low rainfall season. However, this was only a single season trial and further work could be completed to have more confidence in this outcome.

It Is unlikely that different prices would influence the result as any additional fertiliser only result in higher costs with no reward. Therefore, different input prices would only change the angle of the curve and as all prices would result in a loss of profitability.

While the trial's result was negative, there was a clear outcome, which local growers can acknowledge and learn from. The host grower expressed his opinion before the commencement of the trial by saying that the planned treatments were not something he would normally consider on his farm. However, he was still happy to host the trial and the result would give more confidence in the decisions that he had already made.

This trial showed no benefit of using an enhanced efficiency fertiliser such as Green Urea NV. However it was in a scenario where it was unlikely to and does not represent the value that the fertiliser may have in another farming system with different conditions. Therefore, future research should focus on applying Green Urea NV in a scenario where it would provide benefit to the grower an increase in profitability through increased available N and less loss of N to volatilisation.

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