Wheat plots on 12th April 2024

NCS
NITROGEN CLIMATE SMART

CASE STUDY: AGRII YEAR 1 (ARABLE RESEARCH TRIALS)

How much can nitrogen be reduced after winter beans without damaging yield?

As part of the four-year Defra-funded NCS – Nitrogen Efficient Plants for Climate Smart Arable Cropping Systems project – Agrii ran small plot trials in 2023/24 to investigate how winter beans influence nitrogen requirements in the following winter wheat crop.

Nitrogen rates and application strategies

The trials at Cornish Hall End (Essex) and Sharnbrook (Bedfordshire) compared nitrogen strategies for winter wheat following winter beans, testing whether RB209 recommendations could be refined for heavier soils with higher residual nitrogen.

Starting from the RB209 guideline of 190kg N/ha for winter wheat after winter beans, the trials tested the following rates:

- 238kg N/ha (125% of RB209)
- 190kg N/ha (RB209 rate)
- 142kg N/ha (75% of RB209)
- 96kg N/ha (50% of RB209)

Nitrogen recommendations are dependent on winter rainfall levels so should be reviewed annually, also taking soil type into account.

The trials also compared a two-split programme with a three-split programme which included an early application at growth stage (GS) 25. The two-split programme started at GS30 to understand if the residual nitrogen would keep the crop sustained enough until then.

Assessments

Autumn and early spring soil mineral nitrogen (SMN) assessments revealed strong nitrogen retention at 30-60cm, particularly important on the medium and deep clay soils at both trial sites. This confirmed that winter beans provided a substantial residual nitrogen contribution deeper in the profile.

PlentySense nitrogen blades were used to monitor nitrate movement, with the aim of improving understanding of nitrate concentrations in the soil profile across the season.

Drone-based NDVI imagery showed that biomass was higher in spring in the plots that received the GS25 nitrogen applications, compared to the plots which hadn't had the earlier application.

Yield results

Essex Site (Cornish Hall End)

- 142kg N/ha: 9.42 t/ha
- 190kg N/ha: 9.48 t/ha

These near-identical results indicate that nitrogen could be reduced by 25% without sacrificing yield.

The three-split programme produced +0.3t/ha more yield than the two-split regime, likely due to improved early-season biomass and better uptake during a high-rainfall winter.

Ear counts varied little between the 142, 190 and 238kg N/ha treatments. Grain protein and grain nitrogen increased with nitrogen rate, with two-split programmes producing the highest grain protein across treatments.

The results from the Sharnbook site mirrored the Cornish Hall End findings:

- 142kg N/ha: 7.88 t/ha
- 190kg N/ha: 7.95 t/ha

Again, heavier soil types contributed to good nitrogen retention. Some plots achieved the 13% grain protein milling premium, boosting margins significantly.

Gross margins

Economic analysis across both sites highlighted:

- The three-split nitrogen programme produced the highest gross margin across all N rates.
- 142kg N/ha outperformed 190kg N/ha on margin at both sites.

This indicates strong potential for reduced fertiliser inputs without financial compromise.

Environmental footprint

Reducing the nitrogen rate from 190 to 140 kg N/ha led to a decrease in emissions of 163.2 kg CO_2e/ha (from 646 to 482.8 kg CO_2e/ha from nitrogen fertiliser).

Lessons for growers

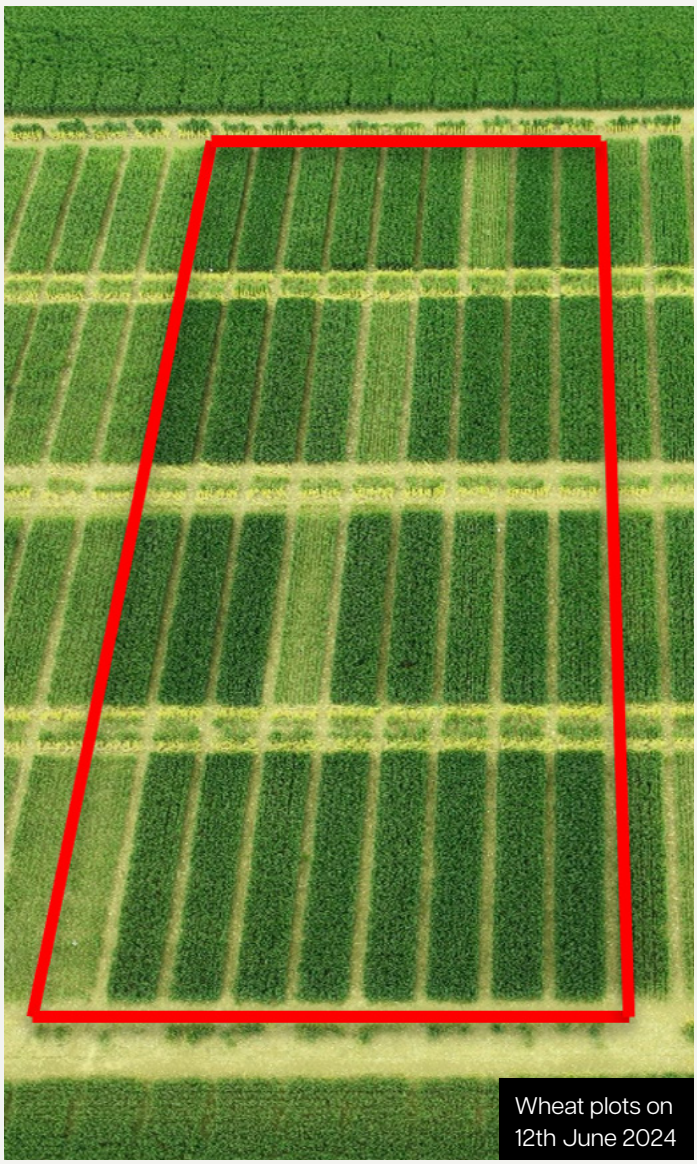
Agrii's early findings from the NCS trials highlighted key opportunities:

- There could be potential to reduce nitrogen rates for wheat following beans, however historic management, cropping, use of organic manure and other practices will all have an impact. Conducting tramline trials of higher and lower nitrogen rates is advised.
- Three-split nitrogen programmes may offer improved nitrogen uptake and higher yields.
- Diagnostic tools such as nitrogen blades can help optimise timing of applications.
- Soil type matters – lighter soils may not allow the same reductions.

"These trials are showing that we can reduce nitrogen by 25% with little effect on yield.

The key is understanding the soil's ability to retain nitrogen and making informed decisions about timing and rates."

Lucy Cottingham, UK Digital Agronomy Development Manager, Agrii



Wheat plots on 12th June 2024

Next steps

Further trials will continue refining nitrogen strategies for wheat following pulses. Ongoing work will explore nitrogen timing, alternative diagnostics, and broader environmental impacts to help growers transition confidently to lower-input, climate-smart rotations.

NCS Project

Nitrogen efficient plants for Climate Smart arable cropping systems (NCS) is a four-year £5.9m research programme aiming to enable UK farming to bring about a reduction of 3.4MtCO2e p/a or 54% of the maximum potential for the industry through increased production and use of pulses. Led by PGRO it involves 200 UK farms and 17 partners. The project is funded by the Farming Futures R&D Fund: Climate smart farming, part of Defra's Farming Innovation Programme. Defra is working in partnership with Innovate UK who are delivering the programme.