ADAS document ref: 1021801-01 (00)
Report author: Katy Hammersley

Project manager and technical reviewer: Susie Roques

Farm location: Rutland
Trial type: Liquid N with Didin inhibitor

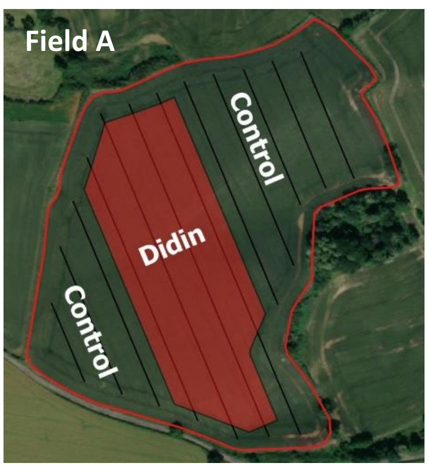
This trial was part of the AICC Crop Nutrition Club 2022, which has been run in conjunction with the Farm-PEP project led by ADAS. This report contains the results of two winter wheat trials testing the effects of liquid N with and without Didin (nitrification and urease inhibitor), and with different numbers of N splits.

Fields and treatments

Two similar trials were conducted in Field A (Lantern, loamy and clayey soil) and Field B (KWS Parkin, loamy soil). In both trials, the treatments were:

1. 220kg/ha N in 3 splits (50/100/70 kg/ha N) using OMEX 22N 10 SO_3
2. 220kg/ha N in one pass using OMEX 22N 10 SO_3 including 8 l/ha Didin

The trials were each designed with a single treatment area and a control area either side.

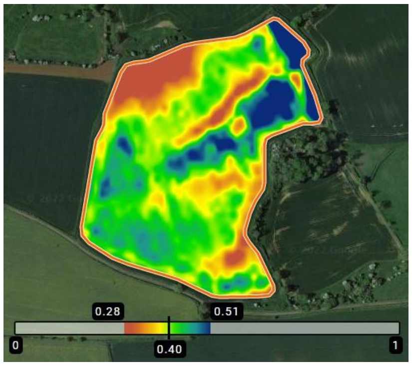


Satellite imagery

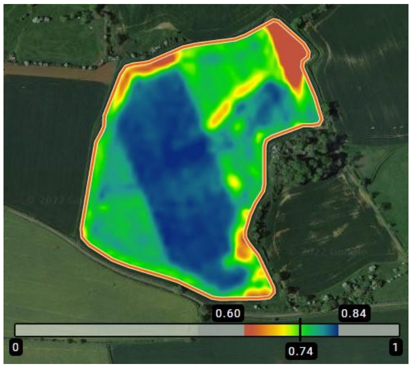
NDVI (normalized difference vegetation index) is a spectral reflectance index which shows a combination of canopy size and greenness, on a scale from 0 to 1. NDVI images were sourced from www.datafarming.com.au, based on freely available 10m resolution data from the Sentinel 2 satellites. The scale varies between images but always runs from red (low) through orange, yellow and green to blue (high). The availability of imagery is constrained by the need for cloudless conditions.

Prior to trial initiation, the main variation in Field A ran across the tramlines so should not have biased the treatment comparison. According to historic satellite images, Field B has been farmed as one but with two tramline directions. Only the east side of the field was included in the yield map analysis, because the Agronomics analysis requires yield data to be in parallel rows.

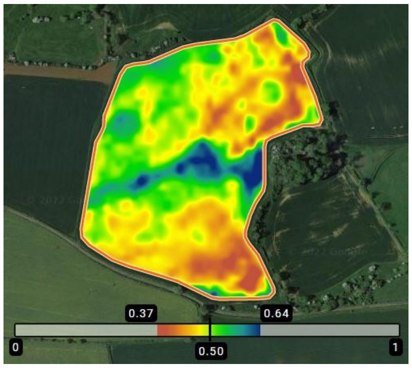
In both fields following the early N splits, Didin treatment area had noticeably higher NDVI in April, as it had received the full 220 kg N/ha but the control treatment was still waiting for its last N split. However, by July the differences had faded, so that NDVI was even across the two treatments.



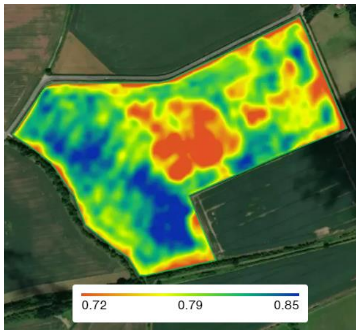
NDVI before treatments (25 Feb)



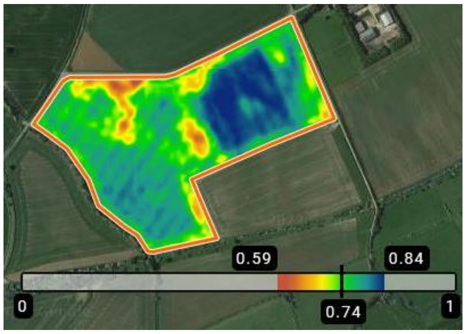
NDVI between N splits (24 Apr)



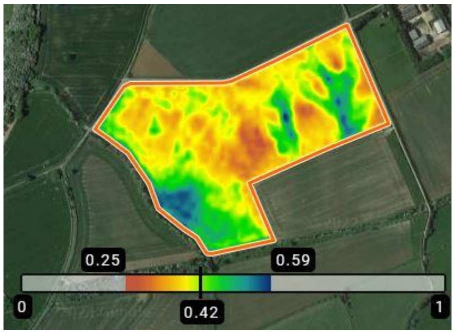
NDVI pre-harvest (13 Jul)



NDVI before treatments (31 Jan)

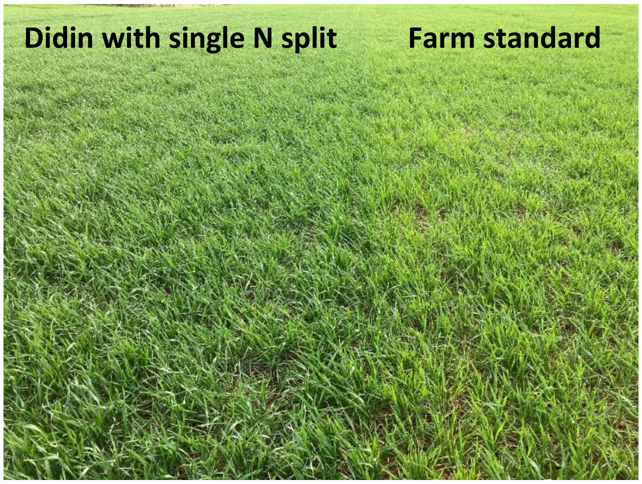


NDVI between N splits (24 April)



NDVI pre-harvest (10 Jul)

The photos below, taken in Field A on 5th April, show the same striking difference in crop greenness between the treatments as the NDVI images.



Agronomics analysis

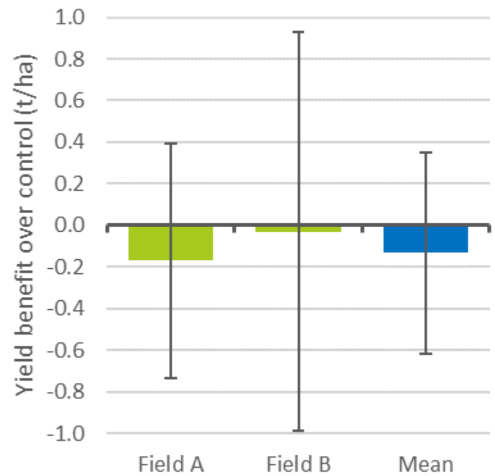
The yield data were analysed using the ADAS Agronomics approach. First the data were cleaned to remove headlands, anomalous combine runs (header not full or spanning two treatment areas), and locally extreme data points, and to correct any offset created by changes in combine direction. In Field A, the precision of the analysis was also improved by excluding combine runs along wheelings. Then a model of underlying variation was applied to the data to account for spatial variation across rows and along rows, and for the effect of the treatment. The statistical analysis led to estimates of the treatment effects and the associated standard errors for each trial. Thus, subject to the assumptions of the underlying statistical model, it was possible to calculate 95% confidence limits for the yield effects and the % probability that the yield effect was greater than any chosen threshold.

The two trial results were combined in a cross-site analysis, with results weighted according to precision; more precise results (smaller standard error) were given a greater weighting.

Yield results

The average measured yields of the control treatment were **12.73 t/ha** in Field A and **13.81 t/ha** in Field B, according to yield map data. These are likely to be a little higher than the true averages due the exclusion of headlands and wheelings from the analysis.

Using the Agronomics analysis to fit a statistical model to the data, we estimate that Didin with a single N timing reduced yield by **0.17 t/ha ± 0.56 t/ha** (95% confidence interval) in Field A and by **0.03 t/ha ± 0.96 t/ha** (95% confidence interval) in Field B, relative to the control treatment. However, measured yield values do vary across a field even when the same treatment is applied everywhere; the bounds of the confidence intervals indicate that, according to the underlying statistical model, these estimated effects could have been the result of this unexplained variation. Similarly, a cross-site analysis of the two trials returned a non-significant yield loss of **0.13 t/ha ± 0.25 t/ha.**



Error bars show 95% confidence intervals

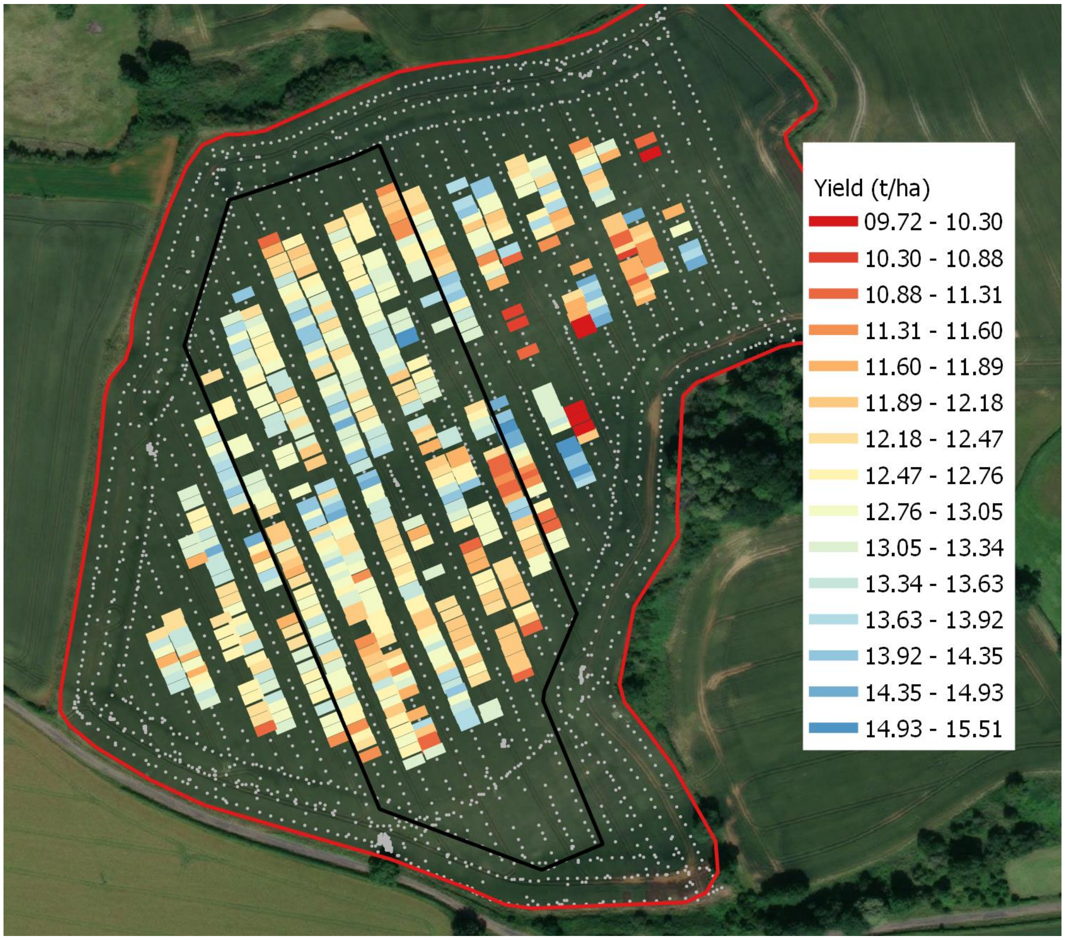
The precision of the yield results could have been improved by replicating the treatments, i.e. laying out the fields with alternating single or double tramlines of each treatment.

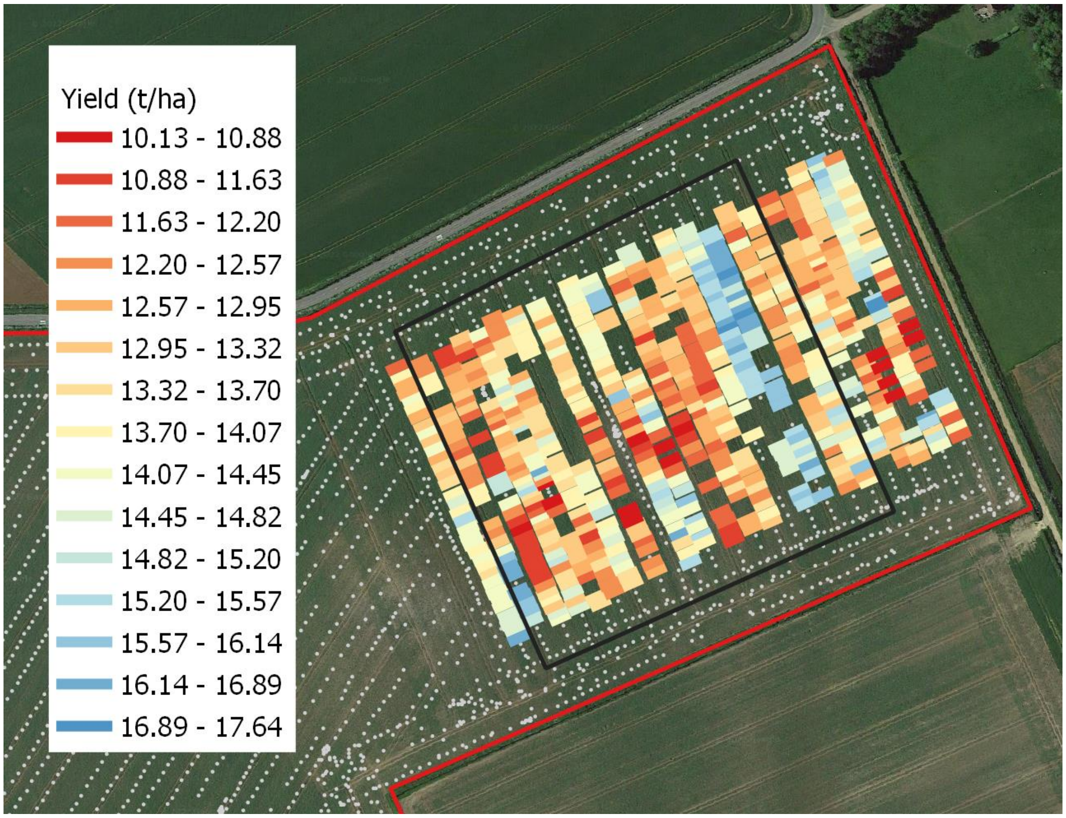
The cost of applying a split of liquid N is approximately £9.91/ha (Nix, 2022), so the saving from missing two N splits to the Didin treatment should be about £19.82/ha. With feed wheat at around £260/t, the estimated mean yield loss was equivalent to about £34/ha, which is greater than the cost saving from reduced application timings, even before accounting for the cost of the Didin.

Other trials have shown significant yield benefits from urease inhibitors, relative to the same N rates and timings without inhibitors; the average benefit is about 0.2 t/ha. But these trials suggest that inhibitors may not sufficiently slow N availability and prevent N losses to allow application of the crop's whole N requirement as a single split.

Relative likelihood of a yield effect of different sizes from the Didin / single N timing programme, according to the cross-site Agronomics analysis of these two trials. Consider the relative costs of the treatment programmes to determine what yield effect would be required for an economic benefit.

Yield benefit or loss relative to control	Didin with single N timing Probability
> (greater than) 0.2 t/ha yield benefit	9 % (very unlikely)
> 0.0 t/ha yield benefit	30 % (unlikely)
> 0.0 t/ha yield loss	70 % (likely)
> 0.2 t/ha yield loss	39 % (about as likely as not)
> 0.4 t/ha yield loss	14 % (unlikely)
> 0.6 t/ha yield loss	3 % (very unlikely)

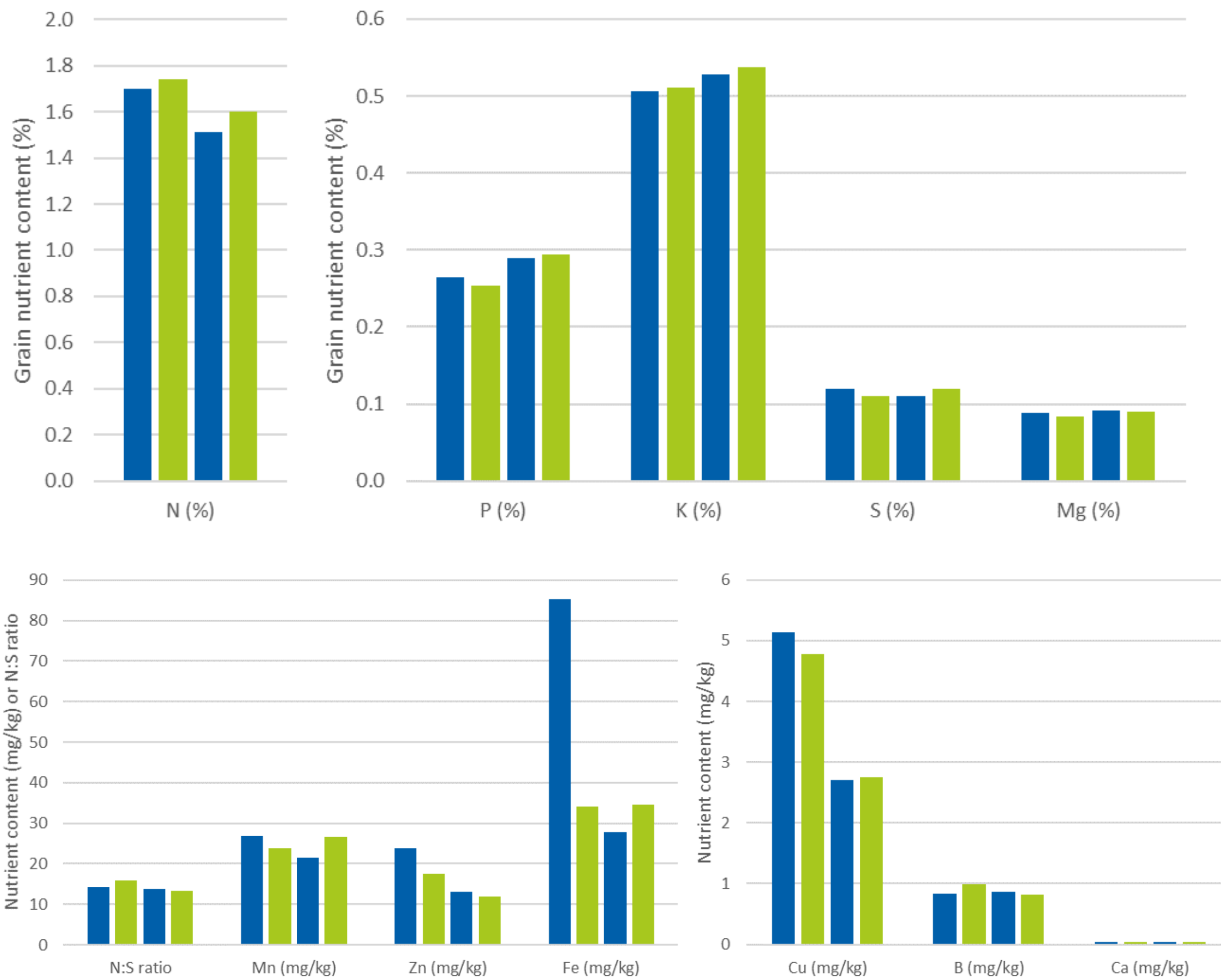

Yield (t/ha)
09.72 - 10.30
10.30 - 10.88
10.88 - 11.31
11.31 - 11.60
11.60 - 11.89
11.89 - 12.18
12.18 - 12.47
12.47 - 12.76
12.76 - 13.05
13.05 - 13.34
13.34 - 13.63
13.63 - 13.92
13.92 - 14.35
14.35 - 14.93
14.93 - 15.51


Yield (t/ha)
10.13 - 10.88
10.88 - 11.63
11.63 - 12.20
12.20 - 12.57
12.57 - 12.95
12.95 - 13.32
13.32 - 13.70
13.70 - 14.07
14.07 - 14.45
14.45 - 14.82
14.82 - 15.20
15.20 - 15.57
15.57 - 16.14
16.14 - 16.89
16.89 - 17.64

Grain analysis results

A grain sample was collected from each treatment in each of the two trials and submitted to NRM's Grain Check service for testing. The number of samples was too small for statistical analysis, but it is notable that in both trials, grain %N was slightly higher in the farm standard control than the Didin treatment. This fits with the trend for slightly lower yields in the Didin treatment. Other nutrients did not show clear or consistent treatment differences.

The grain P concentration in all samples was below the YEN Nutrition critical threshold of 0.32% (mean 0.28%), suggesting possible yield limitation by P supply. The grain N concentration (mean 1.64%) was also below the RB209 benchmark of 1.9%, suggesting possible under-application of N at 'normal' grain and fertiliser prices, although with the current high fertiliser prices, this may just reflect sensible reduction of N rates in the light of the altered break-even ratio. No other nutrient levels showed any caused for concern.



Grain nutrient concentrations from the Didin treatment (blue) and farm standard control (green), with the left-hand pair of bars for each nutrient showing data from Field B and the right-hand pair showing Field A.