ADAS document ref: 1021801-07 (00)
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Trial type: N rate
Farm location: Cambridgeshire

Variety: Gleam
Soil type: Chalky boulder clay

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 a winter wheat trial testing different nitrogen rates

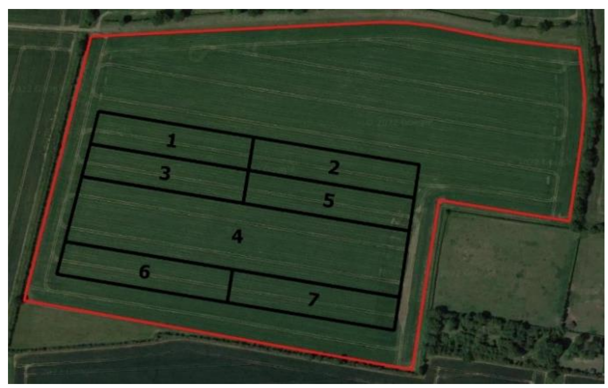
Treatments

Treatment	1	2	3	4 (YEN)	5 (N tester)	6	7 (Efficient 28)
N split							
1 (kg N/ha N26S)	67	67	67	67	67	67	67
2 (kg N/ha N26S)	73	63	83	103	103	93	93
3 (kg N/ha N26S)	53	60	0	80	50	0	0
Other (l/ha)							40 (Efficie-N-t-28)
Total N rate kg N/ha	193	190	150	250	220	160	160 +Ef28

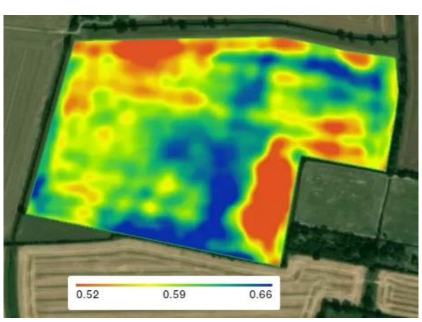
The N tester treatment involved applying the N rate recommended by the hand-held Yara N tester tool. Treatment 4 was entered in ADAS Cereal YEN, hence had a high N rate to target a high yield.

Satellite imagery

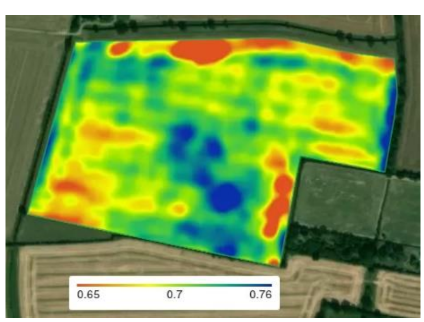
NDVI (normalized difference vegetation index) is a spectral reflectance index which shows a combination of canopy size and greenness, on a scale from 0 to 1. NDVI images were sourced from www.datafarming.com.au, based on freely available 10m resolution data from the Sentinel 2 satellites. The scale varies 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.



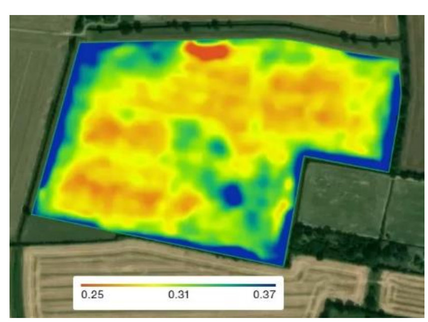
Prior to trial initiation, the main variation in the trial area ran across the tramlines, which ordinarily should not have biased the treatment comparison. However, in this trial, half tramlines were used for most treatments. The underlying variation changed roughly along this split, resulting in the treatments in the east side of the field being in an area of higher NDVI. This variation was visible throughout the season including before treatments were applied, so was unlikely to be due to the treatment differences. In June and July, treatments 3 and 6 (those with the lowest N rates) stood out as having lower NDVI than neighbouring treatments.



NDVI before treatments (24 Mar)



NDVI after treatments (22 Jun)



NDVI pre-harvest (10 Jul)

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), wheelings, and locally extreme data points, and to correct any offset created by changes in combine direction. 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. 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.

Treatment 4 (the 250 kg N/ha YEN treatment) was used as the control to compare all other treatments to, because it occupied a greater area than other treatments and was adjacent to most treatments.

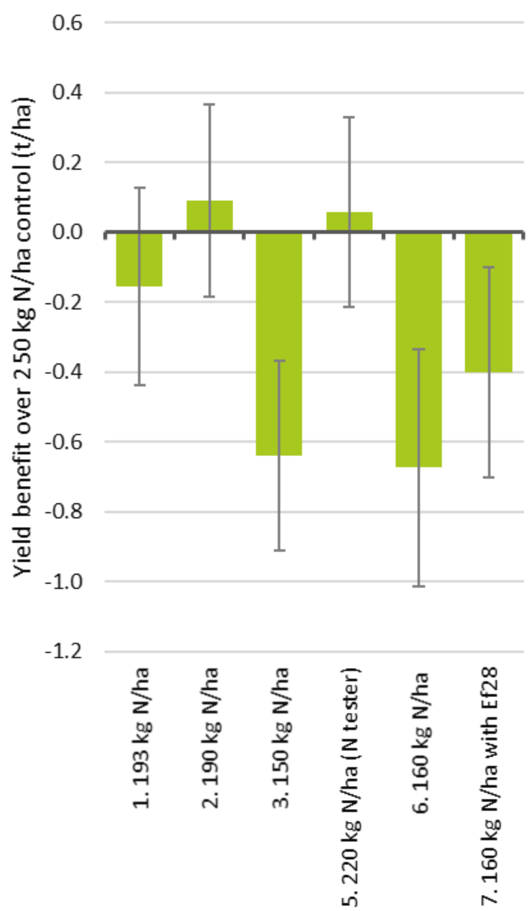
Yield results

The average measured yield of treatment 4 (YEN 250 kg N/ha) was **12.87 t/ha**, according to yield map data. This is likely to be a little higher than the true average 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 reducing the N rate to 150 kg N/ha (treatment 3) or 160 kg N/ha (treatment 6) reduced yield by **0.64 t/ha ± 0.27t/ha** (95% confidence interval) or **0.67 t/ha ± 0.34 t/ha**, respectively. Although 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 are unlikely to have been the result of this unexplained variation.

The addition of Effcien-N-t-28 increased yield by **0.27 t/ ha ± 0.42 t/**ha, compared with treatment 6 which had the same main applications of N. However, the eastern half of the trial area yielded approximately 0.25 t/ha more than the western half, based on comparison between treatments 1 and 2 which had similar N rates. Treatments 2, 5 and 7 were in the higher yielding eastern part of the trial area, while treatments 1, 3 and 6 were in the poorer western part of the trial area. Consequently, it is very doubtful whether the difference between treatments 6 and 7 was due to the addition of Efficie-N-t-28, or just to the underlying variation.

Treatments 1, 2 and 5 (193, 190 and 220 kg N/ha) showed negligible yield differences from the 250 kg N/ha control (treatment 4).



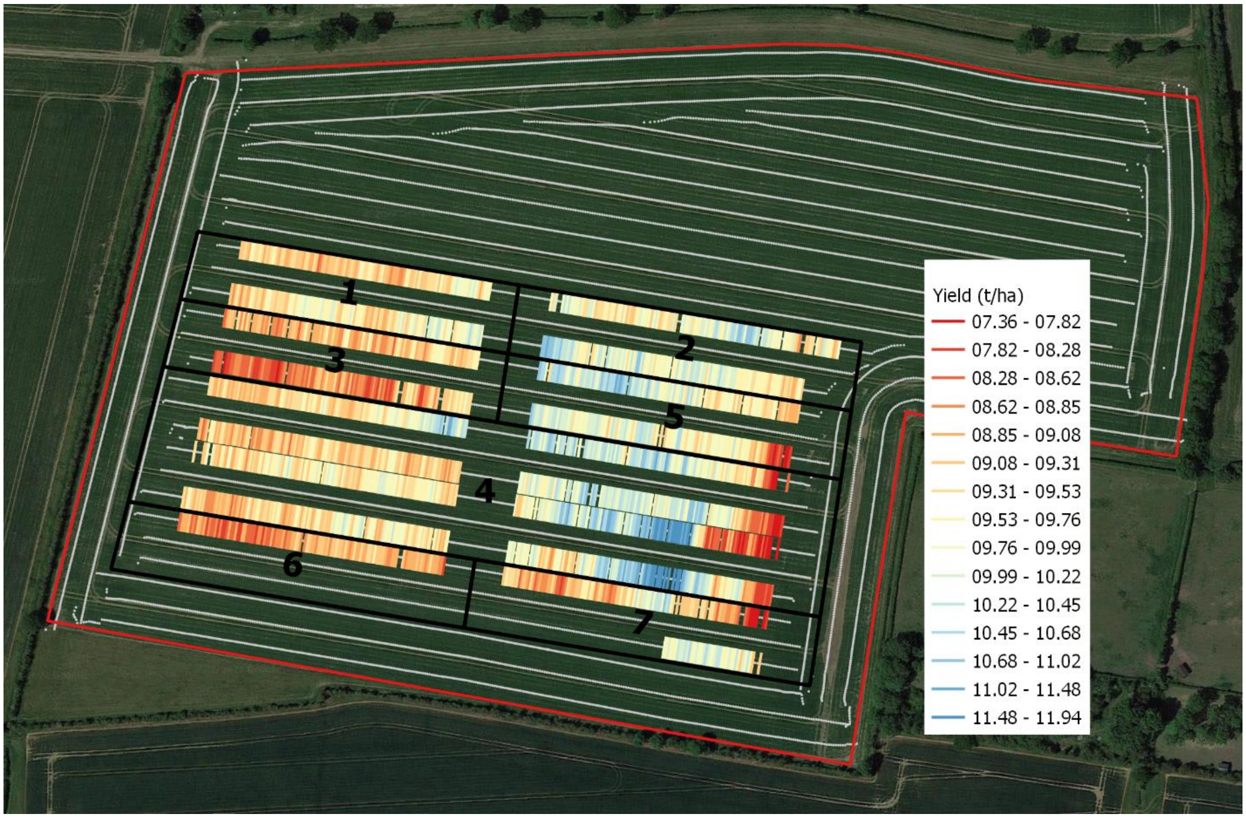
Error bars show 95% confidence intervals

With a break-even ratio of 10 (cost of 1 kg N = price of 10 kg grain), the cost saving from reducing the N rate by 30 kg/ha is equivalent to the value of 0.3 t/ha grain. So, reducing the N rate even as far as 150 kg N/ha appears to have had a positive impact on the gross margin of the crop, although the exact value will depend on your own grain price and fertiliser costs.

Relative likelihood of a yield effect of different N rates, according to the Agronomics analysis of this trial. Consider the relative costs of the treatment programmes to determine what yield benefit would be required for an economic benefit.

Yield benefit or loss relative to control (250 kg N/ha)	193 kg N/ha Probability	190 kg N/ha Probability	150 kg N/ha Probability
> (greater than) 0.2 t/ha yield benefit	1 % (very unlikely)	22 % (unlikely)	0 % (exceptionally unlikely)
> 0.0 t/ha yield benefit	14 % (unlikely)	74 % (about as likely as not)	0 % (exceptionally unlikely)
> 0.0 t/ha yield loss	86 % (likely)	26 % (unlikely)	100 % (virtually certain)
> 0.2 t/ha yield loss	38 % (about as likely as not)	2 % (very unlikely)	100 % (virtually certain)
> 0.4 t/ha yield loss	5 % (very unlikely)	0 % (exceptionally unlikely)	96 % (very likely)
> 0.6 t/ha yield loss	0 % (exceptionally unlikely)	0 % (exceptionally unlikely)	61 % (about as likely as not)
> 0.8 t/ha yield loss	0 % (exceptionally unlikely)	0 % (exceptionally unlikely)	12 % (unlikely)

Yield benefit or loss relative to control (250 kg N/ha)	220 kg N/ha (N tester) Probability	160 kg N/ha Probability	160 kg N/ha with Efficie-N-t-28 Probability
> (greater than) 0.2 t/ha yield benefit	15 % (unlikely)	0 % (exceptionally unlikely)	0 % (exceptionally unlikely)
> 0.0 t/ha yield benefit	66 % (about as likely as not)	0 % (exceptionally unlikely)	0 % (exceptionally unlikely)
> 0.0 t/ha yield loss	34 % (about as likely as not)	100 % (virtually certain)	100 % (virtually certain)
> 0.2 t/ha yield loss	3 % (very unlikely)	100 % (virtually certain)	90 % (likely)
> 0.4 t/ha yield loss	0 % (exceptionally unlikely)	94 % (very likely)	50 % (about as likely as not)
> 0.6 t/ha yield loss	0 % (exceptionally unlikely)	66 % (about as likely as not)	10 % (very unlikely)
> 0.8 t/ha yield loss	0 % (exceptionally unlikely)	23 % (unlikely)	0 % (exceptionally unlikely)



Future trials

Trial designs in which the treatment changes within a tramline, as in this trial, often give a greater precision and higher confidence in yield effects. However, this trial was placed over an area of variation such that the treatments were each confined to one side of the variation (except for the control), creating a bias in favour of treatments on the eastern side of the field. Placing treatments evenly across variation can negate underlying effects on yield. In this case, full tramlines of each treatment would have been preferable.

In any future trials, seek to use even fields, or fields where the variation runs across the tramlines to affect all treatment equally. To assess underlying variation prior to trial design, look at soil maps, previous yield maps and/or satellite imagery. Replicating treatments should also improve the precision of the yield results and hence the confidence we can have in any yield effects; treatment replication can be facilitated by reducing the number of treatments in the trial.