ADAS document ref: 1021801-05 (01)
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Trial type: N rate
Farm location: Harlow

Variety: KWS Extase
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

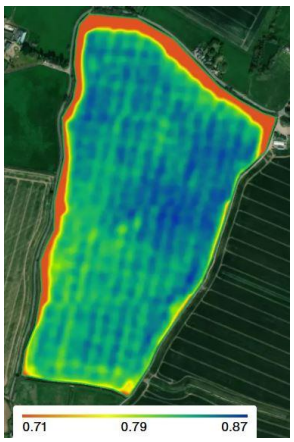
Trt	1	2	3	4	5
Late Feb	80 kg N/ha Urea				
GS30 Mid Mar	60 kg N/ha Piamon				
GS32 Late Apr	Nil N	40 kg N/ha Urea	80 kg N/ha Urea	120 kg N/ha Urea	N tester 0 kg N/ha
Total N rate (kg N/ha)	140	180	220	260	140

The N tester treatment involved applying the N rate recommended by the hand-held Yara N tester tool; in this crop, it recommended no further N at GS32.

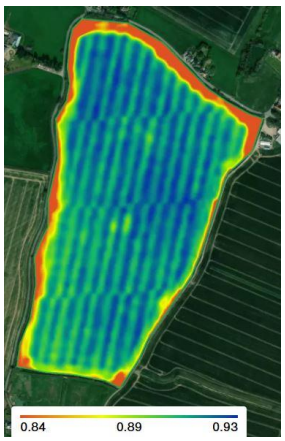
Satellite imagery

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.

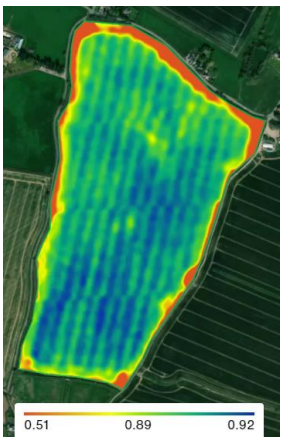
Prior to trial initiation, the main variation in the field ran across the tramlines so should not have biased the treatment comparison, and the area chosen for the trial was very even. After treatment applications, the plots with lowest N rates showed as low NDVI areas from June until harvest.



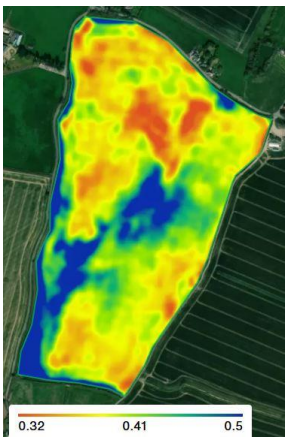
Pre-treatment (24 Mar)



Post-treatment (08 May)



Post-treatment (15 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.

Yield results

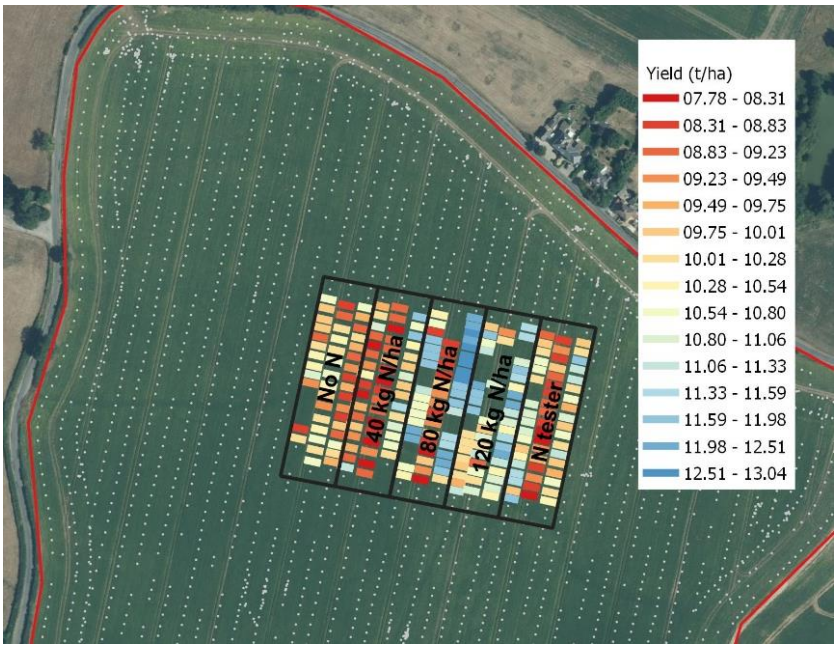
The average measured yield of the 140 kg N/ha treatment was **10.08 t/ha**, according to yield map data. This is likely to be a little higher than the true average due the exclusion of headlands from the analysis.

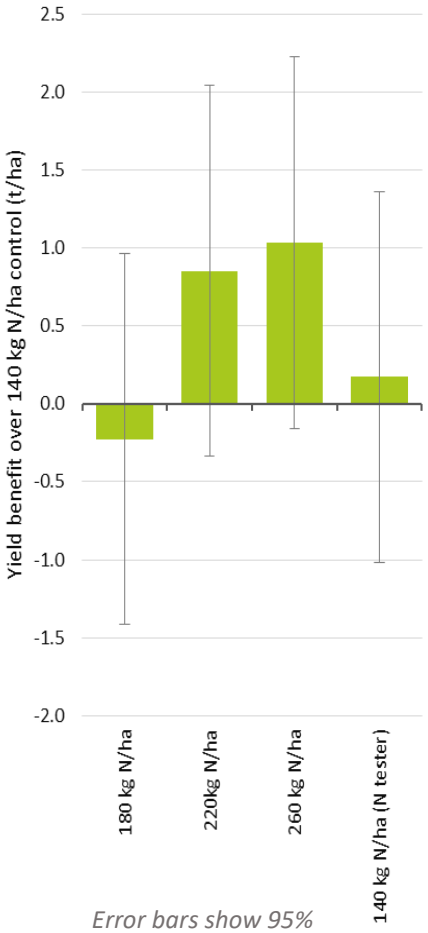
Using the Agronomics analysis to fit a statistical model to the data, we estimate that increasing the N rate from 140 kg/ha to the maximum rate of 260 kg N/ha increased yield by **1.03 t/ha ± 1.19 t/ha** (95% confidence interval). Measured yield values do vary across a field even when the same treatment is applied everywhere; the bounds of the confidence intervals indicate that, according to the underlying statistical model, the estimated effects could have been the result of this unexplained variation. However, the NDVI differences described above support the estimated yield effects, so they probably were 'real' effects, just with large confidence intervals due to the small plot sizes.

Using a current feed wheat price of £260/t and urea fertiliser at £850/t, each 40 kg/ha increase in N rate would need to result in a yield increase of 0.28 t/ha to maintain gross margin. The estimated yield increases in this trial were larger in treatments 3 and 4, suggesting that in this field, the N rates of 220 kg/ha and 260 kg/ha could give the best gross margin if we had more confidence in the results. However, the prices of wheat and fertiliser continue to fluctuate and we have not considered grain quality and milling wheat premiums; the exact impact of N rate on gross margin will depend on your own grain price and fertiliser costs.

Relative likelihood of a yield effect of different sizes from N-rate treatments, 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 (140 kg N/ha)	180 kg N/ha Probability	220 kg N/ha Probability	260 kg N/ha Probability
> (greater than) 1.2 t/ha yield benefit	<1 % (exceptionally unlikely)	28 % (unlikely)	39 % (about as likely as not)
> 0.9 t/ha yield benefit	3 % (very unlikely)	47 % (about as likely as not)	59 % (about as likely as not)
> 0.6 t/ha yield benefit	9 % (very unlikely)	66 % (about as likely as not)	76 % (likely)
> 0.3 t/ha yield benefit	19 % (unlikely)	82 % (likely)	89 % (likely)
> 0.0 t/ha yield benefit	35 % (about as likely as not)	92 % (very likely)	96 % (very likely)
> 0.0 t/ha yield loss	65 % (about as likely as not)	8 % (exceptionally unlikely)	4 % (very unlikely)
> 0.3 t/ha yield loss	45 % (about as likely as not)	3 % (very unlikely)	1 % (very unlikely)
> 0.6 t/ha yield loss	27 % (unlikely)	1 % (very unlikely)	<1 % (exceptionally unlikely)





Error bars show 95% confidence intervals.

Future trials

The trial was well placed in the field within an even area; in any future trials, continue to use even fields, or fields where the variation runs across the tramlines to affect all treatment equally. Avoid fields with too many trees and pylons, as they disrupt both treatments and harvesting.

The numbers of data points in this trial to be analysed was very low, which led to low precision (large confidence intervals) in the Agronomics analysis: this could be improved by extending the trial area the full length of the tramlines.

The precision of the yield results could have been greatly improved by replicating the treatments, which would then allow greater confidence in the yield results. Replication could be facilitated by reducing the number of different treatments, e.g. laying out the field with alternating single or double tramlines of just two treatments.