Making Nitrogen Work Smarter

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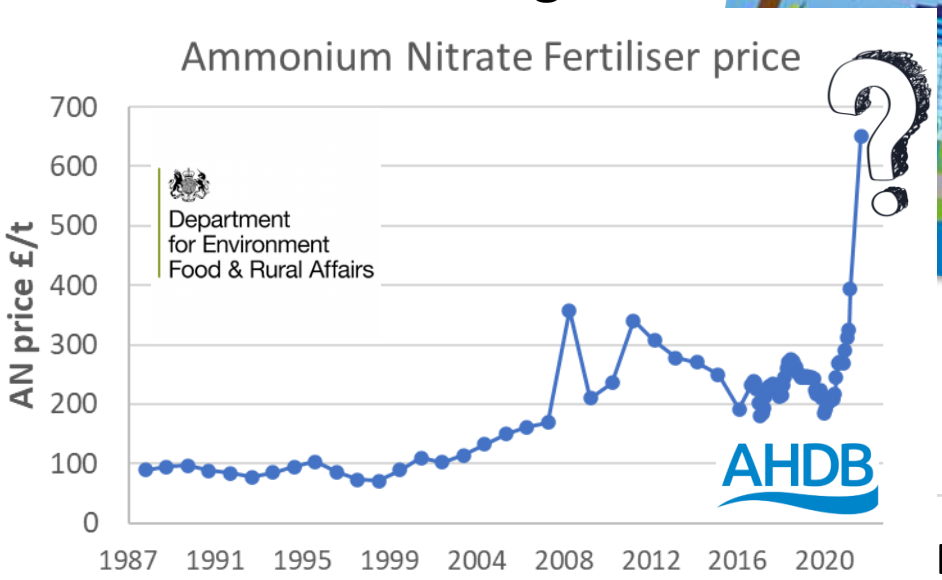
24-25 November CropTec Seminar

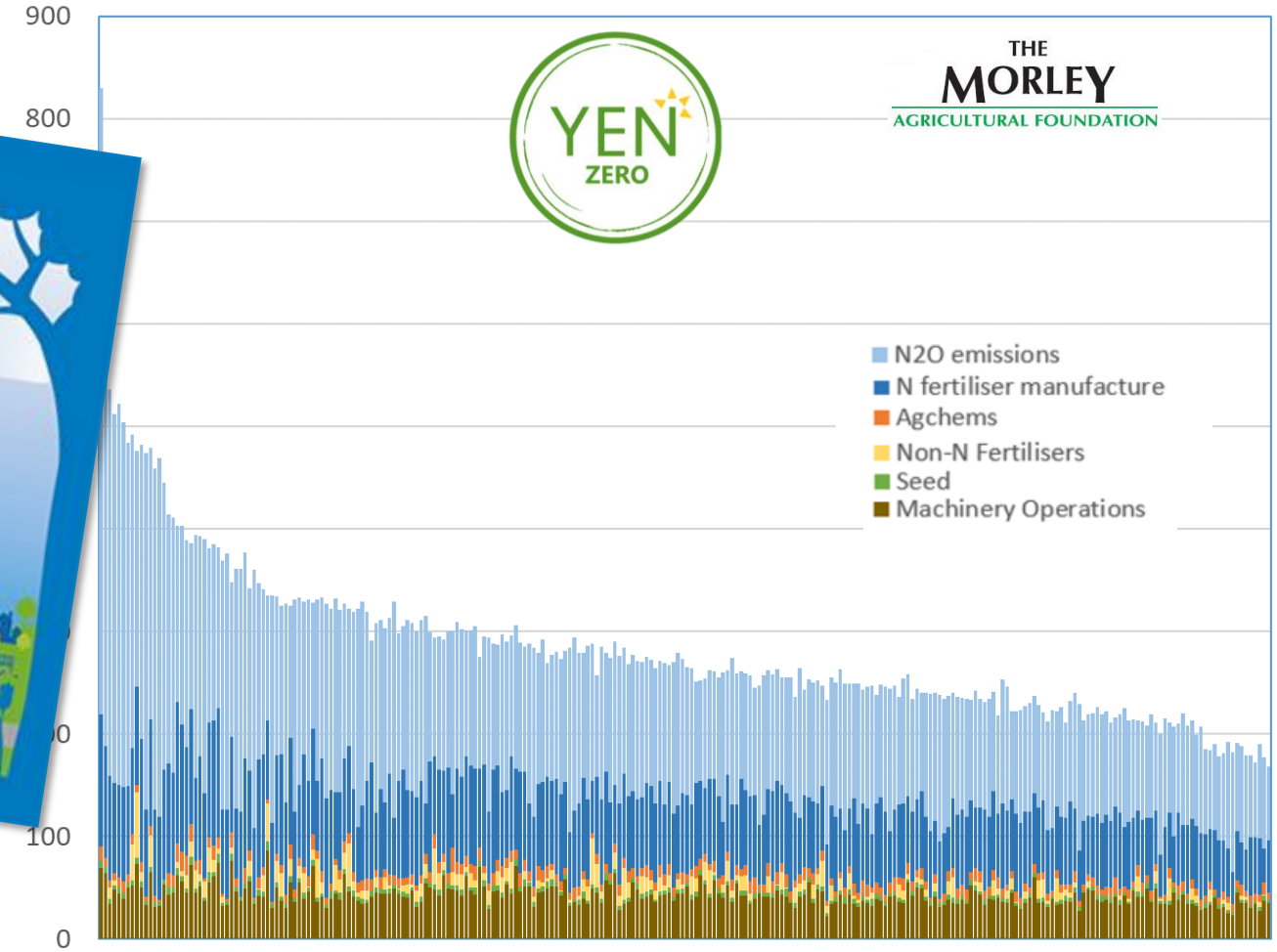
www.adas.uk

Drivers to improve (reduce) N use

N Costs –

- Carbon from manufactu
- Nitrous oxide emissions
- Ammonia emissions
- Nitrate leaching





Defra Agricultural Price Index

Routes to reduce N requirement

Reduce demand for N in the system

- grow crops with low N requirement – species & varieties

Reduce N losses from the system

- cover crops over winter
- fertiliser efficiency & accuracy

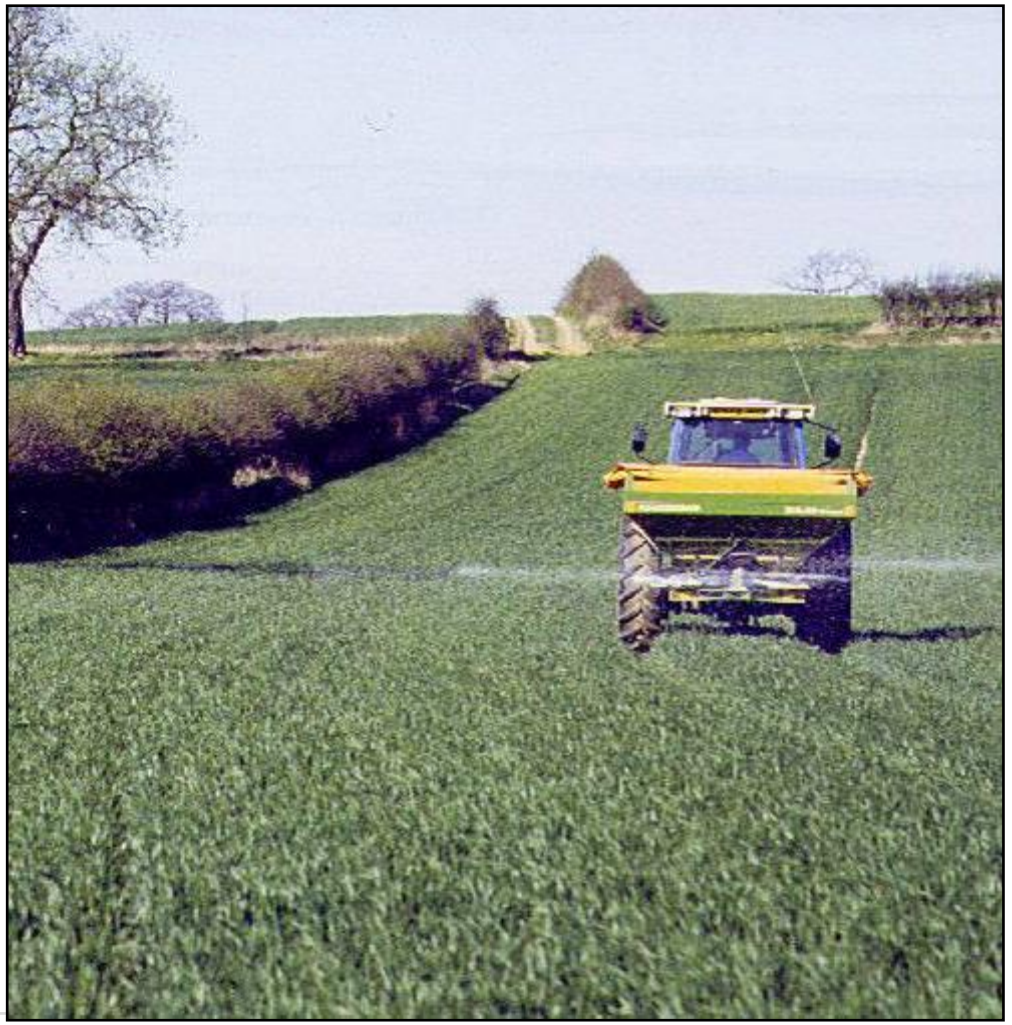
Use available info to **judge your N requirement**

- Fully account for the N from the soil and manures
- Judge past successes
  - … grain analysis
  - … experiment on-farm

Adjust appropriately for the price of N

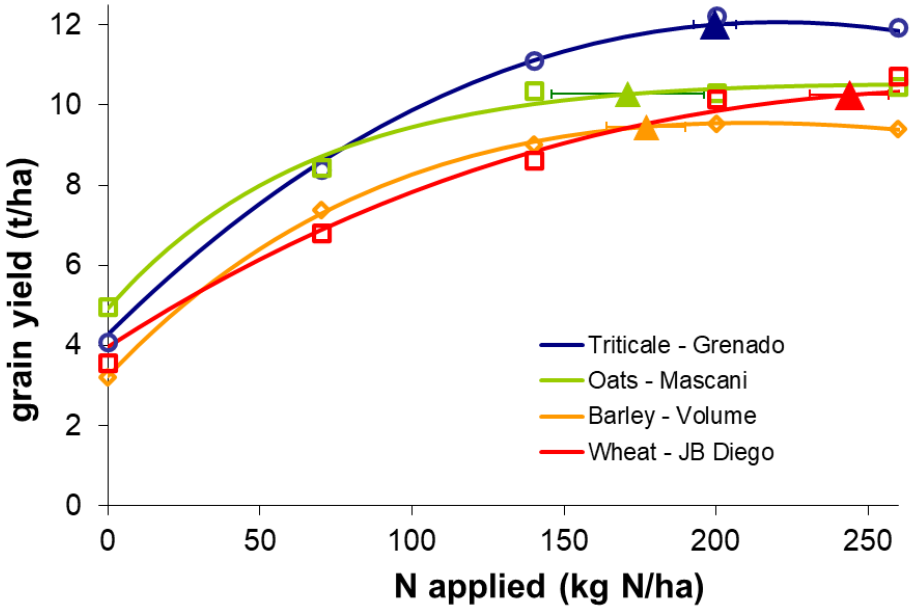
- Consider the Opportunity cost

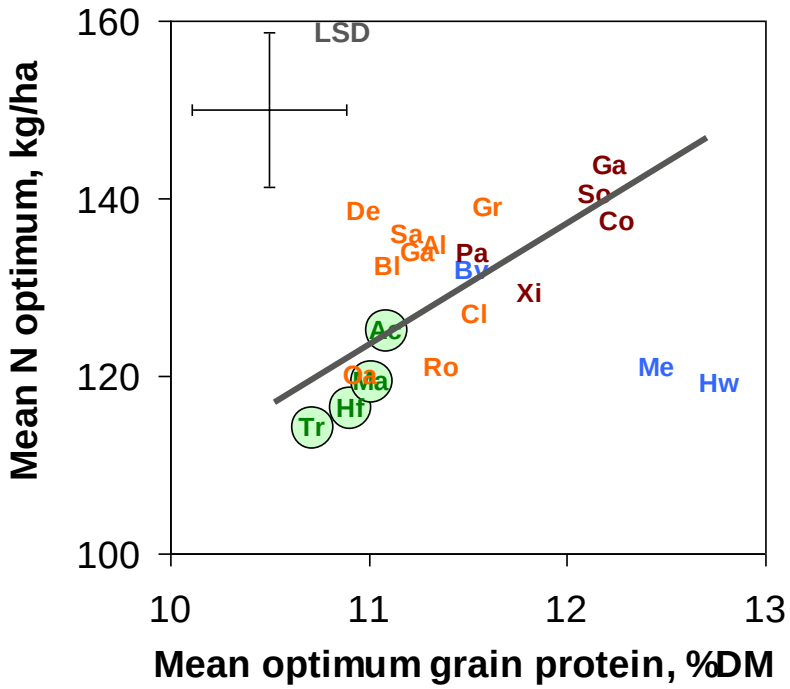
Monitor crops to avoid deficiency and excess



Grow Low N crops

Species N response experiment 2009





Defra HYLO variety N response experiments 2011 & 2012

Consider growing triticale, oats or barley rather than wheat?

… feed wheat rather than milling wheat?

Peas or beans rather than OSR?

… low protein varieties have lower N requirements (at given yield level)

Breeders beginning to introduce varieties with low-N traits … eg Limagrain N-Flex OSR

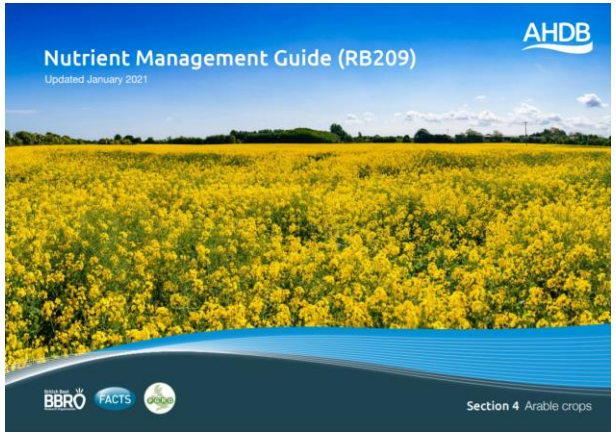
How to decide how much N to buy? … & then apply?

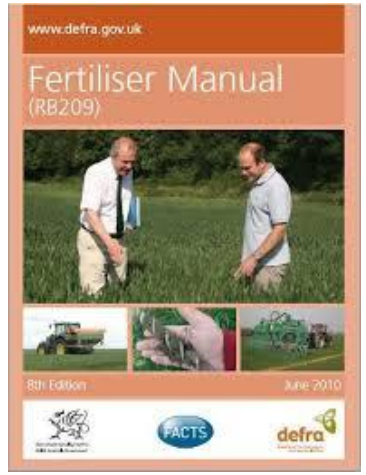
Economic decision, based on return on investment

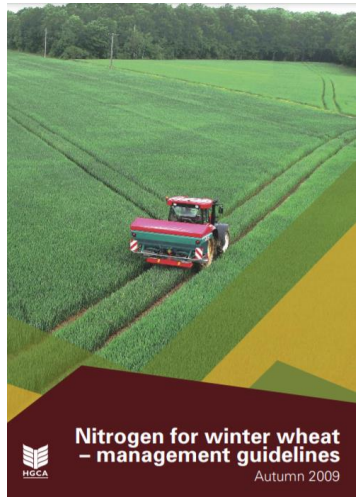
- (within NVZ compliance)
- N requirement is the rate that maximises profit

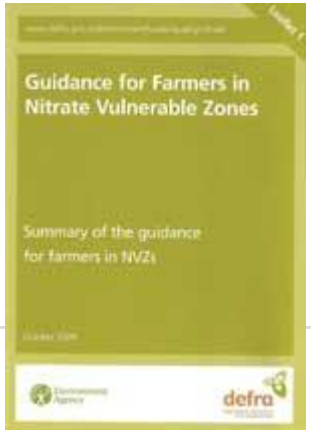
Recommendations are right on average

- But mask huge variabiity
- Can be improved with on-farm experience
- Need to adjust for price changes





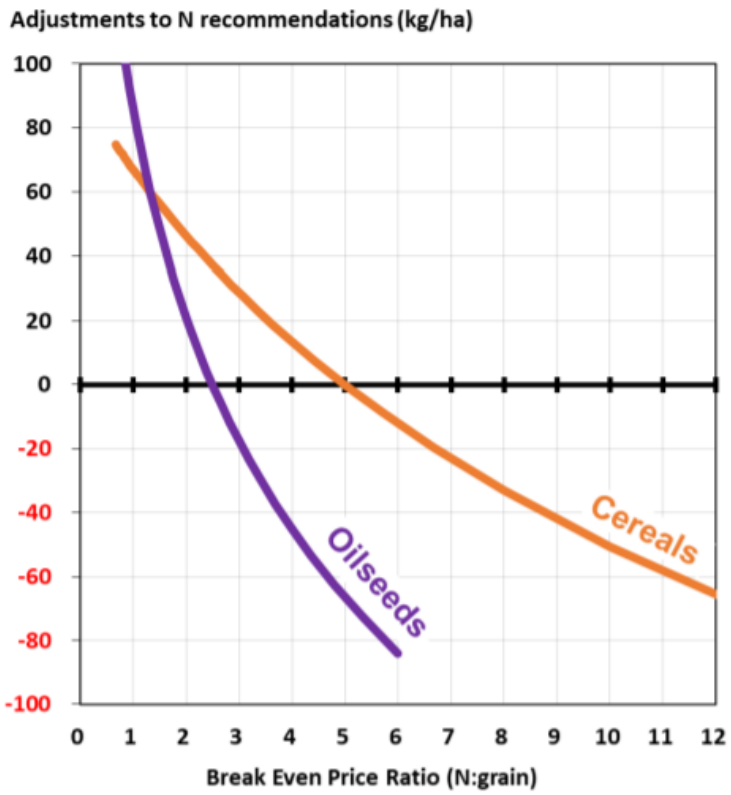




Adjusting N rates to prices

What price did you buy at?

What is the replacement cost?



Cereals – deviations from RB209 recommended N rates

Source of N	Fertiliser N content	Fertiliser Cost								
	%	£/tonne product								
Ammonium Nitrate	34.50%	£173	£259	£345	£431	£518	£604	£690	£776	£863
Urea	46.00%	£230	£345	£460	£575	£690	£805	£920	£1,035	£1,150
Urea-Ammonium Nitrate Liquid	28.00%	£140	£210	£280	£350	£420	£490	£560	£630	£700
Cost of fertiliser nitrogen	*£/kg N*	£0.50	£0.75	£1.00	£1.25	£1.50	£1.75	£2.00	£2.25	£2.50
Grain sale price		Change to recommendation for ALL CEREALS								
	£/tonne	kg/ha N								
	100	0	-30	-50	-70	-85	-100	-115	-125	-135
	125	15	-10	-35	-50	-65	-80	-90	-105	-115
decrease	150	25	0	-20	-35	-50	-65	-75	-85	-95
increase	175	30	10	-10	-25	-40	-50	-60	-70	-80
	200	35	15	0	-15	-30	-40	-50	-60	-70
	225	40	25	5	-5	-20	-30	-40	-50	-60
	250	45	30	15	0	-10	-25	-35	-40	-50
	275	50	35	20	5	-5	-15	-25	-35	-45

AHDB report available online…

https://ahdb.org.uk/how-best-to-respond-to-costly-fertiliser-nitrogen-for-use-in-2022

Economics of the N response

N requirement defined as economic optimum:

- N rate at which extra kg of N applied isn't paid for by value of additional grain yield

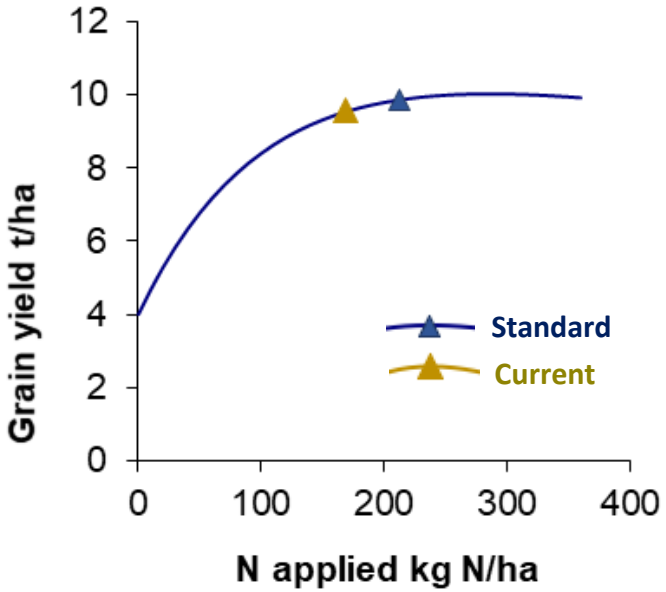
Defined by the **Breakeven Ratio (BER)** – the kg of grain to pay for 1 kg of fertilizer N…

- Historically 3:1 (Grain ~£100/t, AN Fertiliser ~£100/t … £0.3/kg N)
- Since 2009 5:1 (Grain ~£150/t, AN £260/t)
- Current ~10:1 (Grain £200/t, AN ~£700/t … £2/kg N)

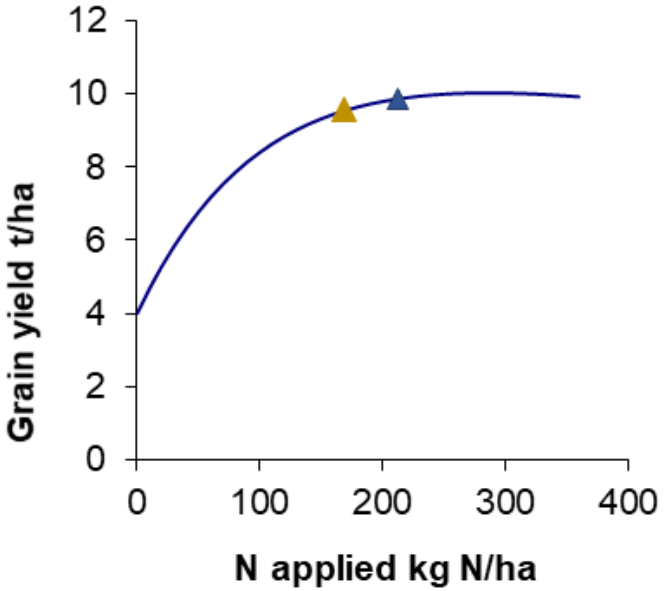
Adjustments given in RB209

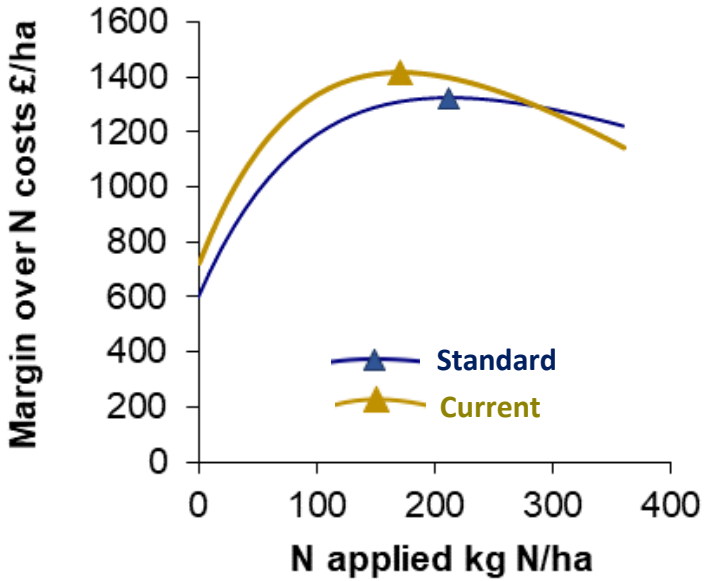
… but rule of thumb **reduce N rate by 10kg/ha for each 1 unit increase in BER**

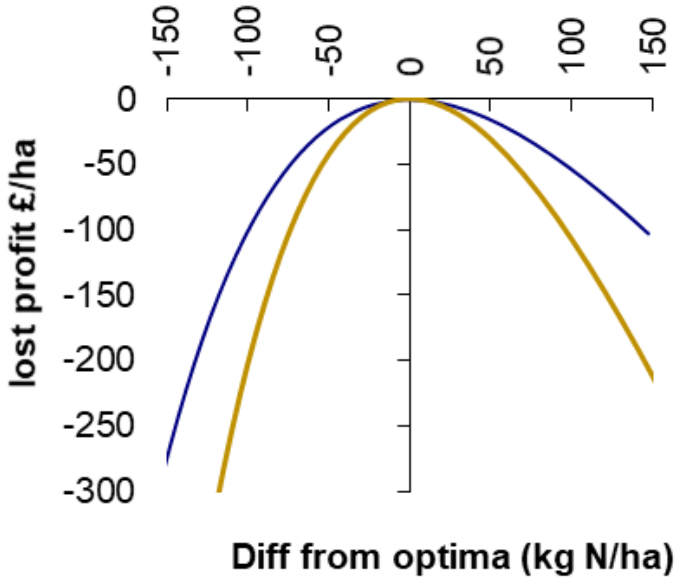
- At current prices we should be applying **50 kg N/ha less** than last year



Costs of getting N wrong are modest within 50kg N/ha





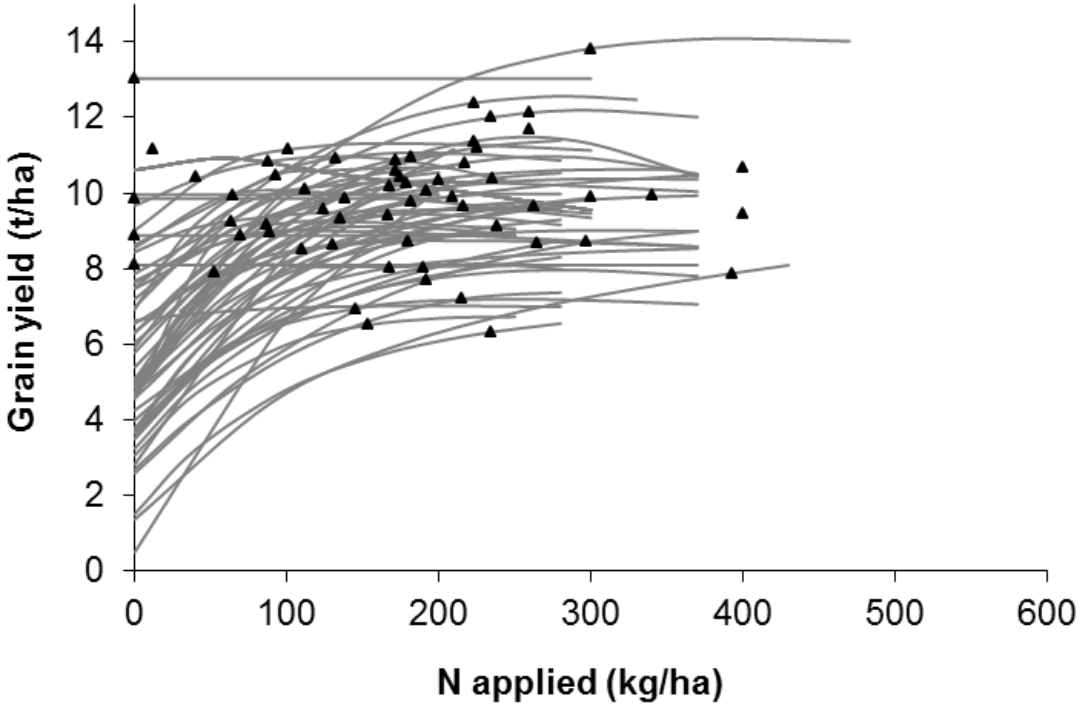


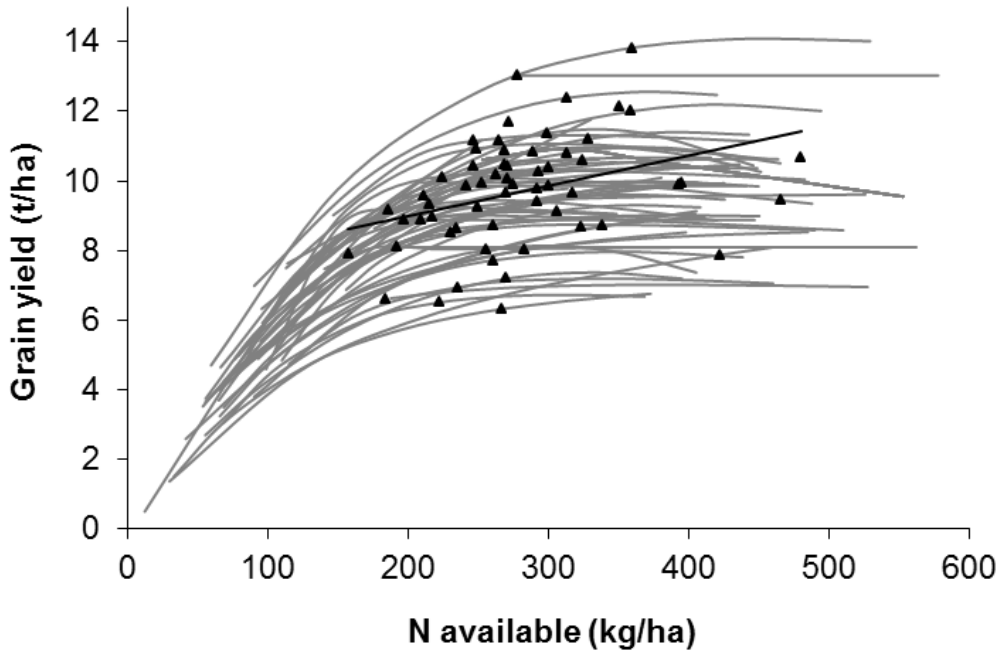
But as we reduce rates and get closer to the shoulder the costs of being wrong increase

… becomes more important to monitor crops to ensure not deficient (… or wasting fertilizer)

At current prices the lost profit from not adjusting N rates (ie sticking to 200kg N/ha rather than ~150kg N/ha) is around £30/ha

Variability in N responses





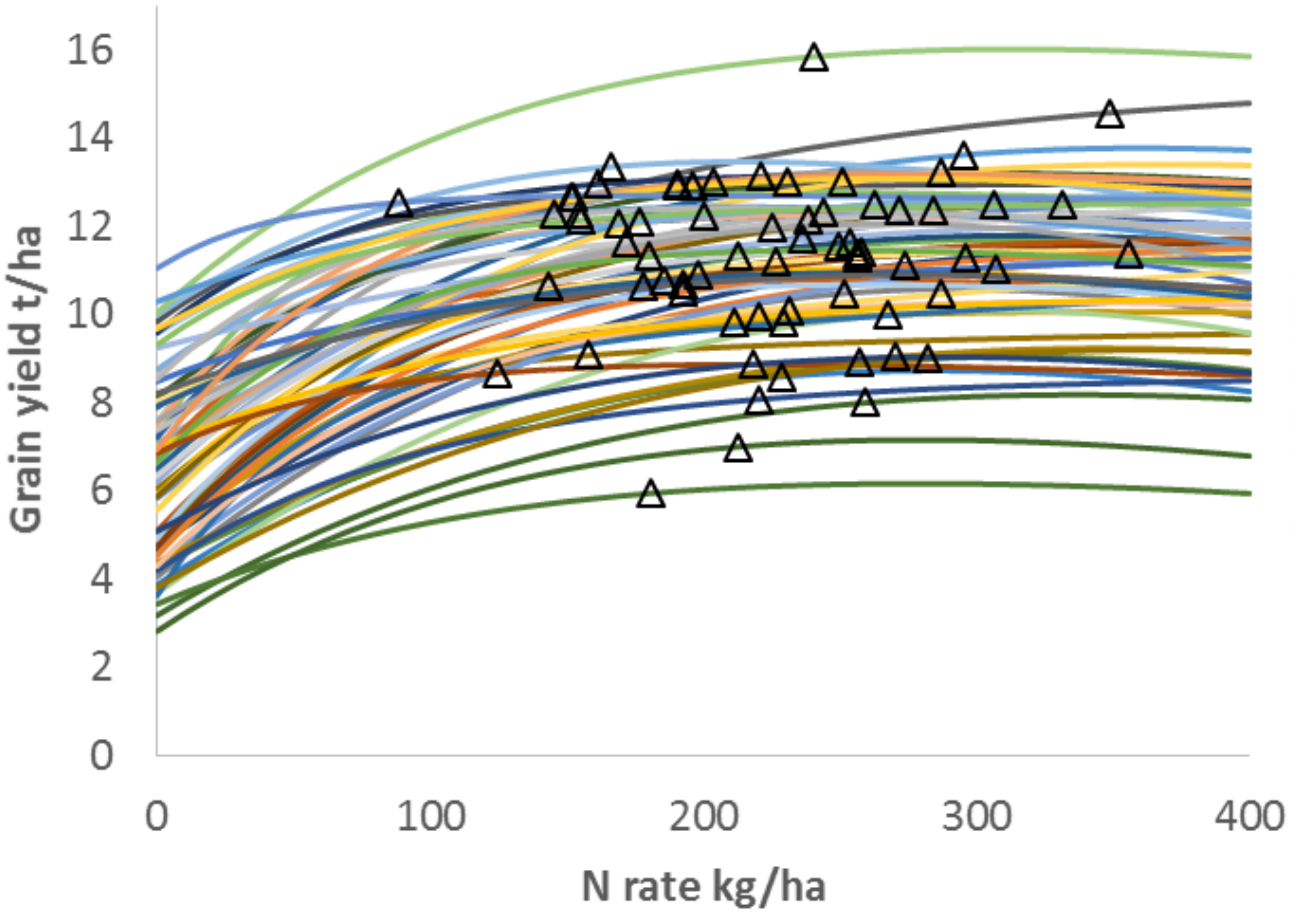
Main driver is soil N supply

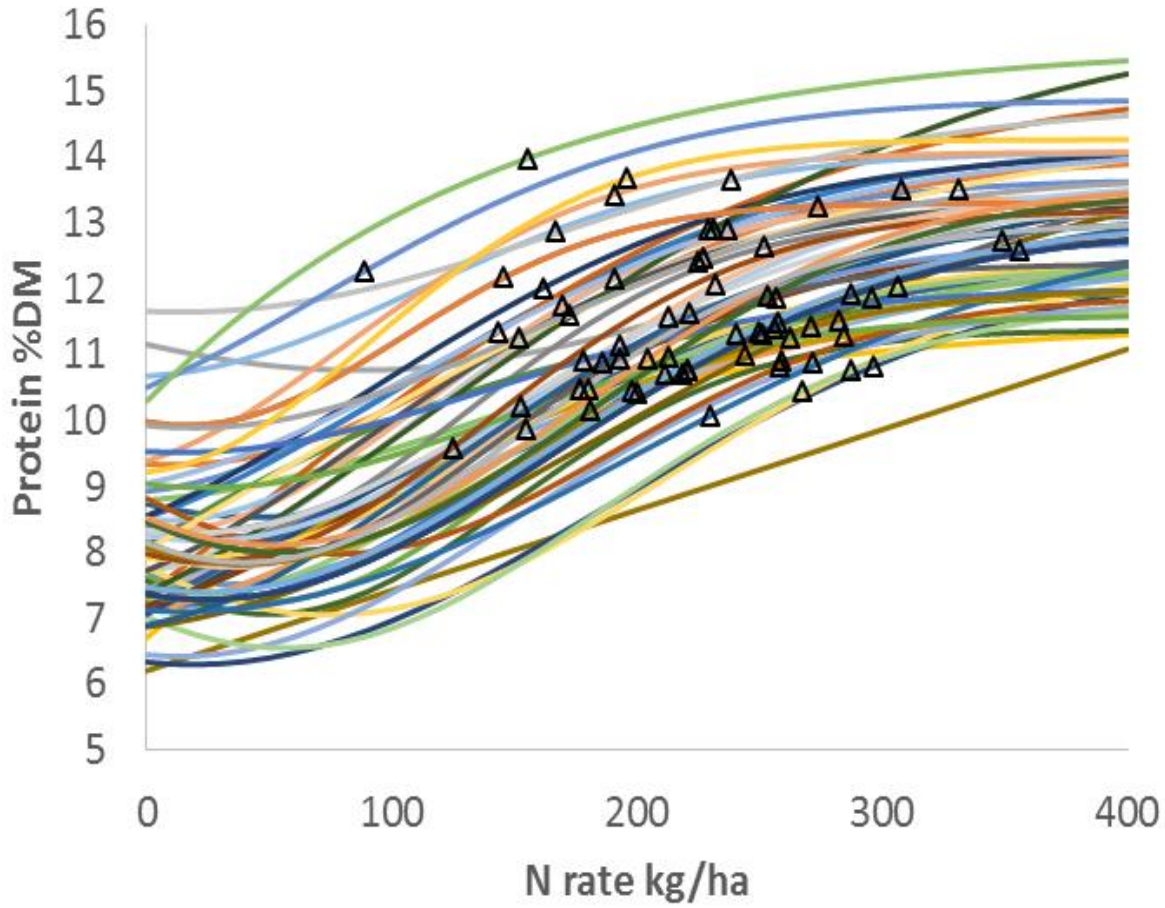
Weak relationship with yield – higher yielding crops warranting more N

But Variation in achieved yields between fields is little to do with N applied

Shape of curves relatively consistent

LearN responses from core sites 2014-2017





Deciding what N rates are right for my farm

Strategic decision – Use **experience** to judge past success to inform future decisions

- Yields, Lodging, misses & overlaps, N offtake & NUE metrics
- Soil Mineral N, organic matter and mineralization measures
- Manures
- Grain analysis – grain protein indicates optima (@5:1 BER):
  - 11% for feed wheat
  - 12% for milling
- Test different N rates on farm
  - Apply 50kg N/ha more or less in alternate tramlines

SNS Best Practice 2012

2009

Make the most of muck

Nutrient value of

Cattle FYM now £11/t … £450/ha @ 40 t/ha

Pig Slurry now worth £6/t … £300/ha @ 50m3/ha

	Cattle manure			Pig slurry (4% DM)		
	kg/ha	£/t	£/ha	kg/ha	£/t	£/ha
Crop available N	24	0.87	35	99	2.87	144
Total phosphate	128	3.51	141	75	1.65	82
Total potash	376	6.89	276	110	1.61	81
Total £		11.28	451		6.13	307

Slurry bandspreading / shallow injection reduces ammonia losses and odour nuisance

Allows application to growing crop

- increases N uptake.

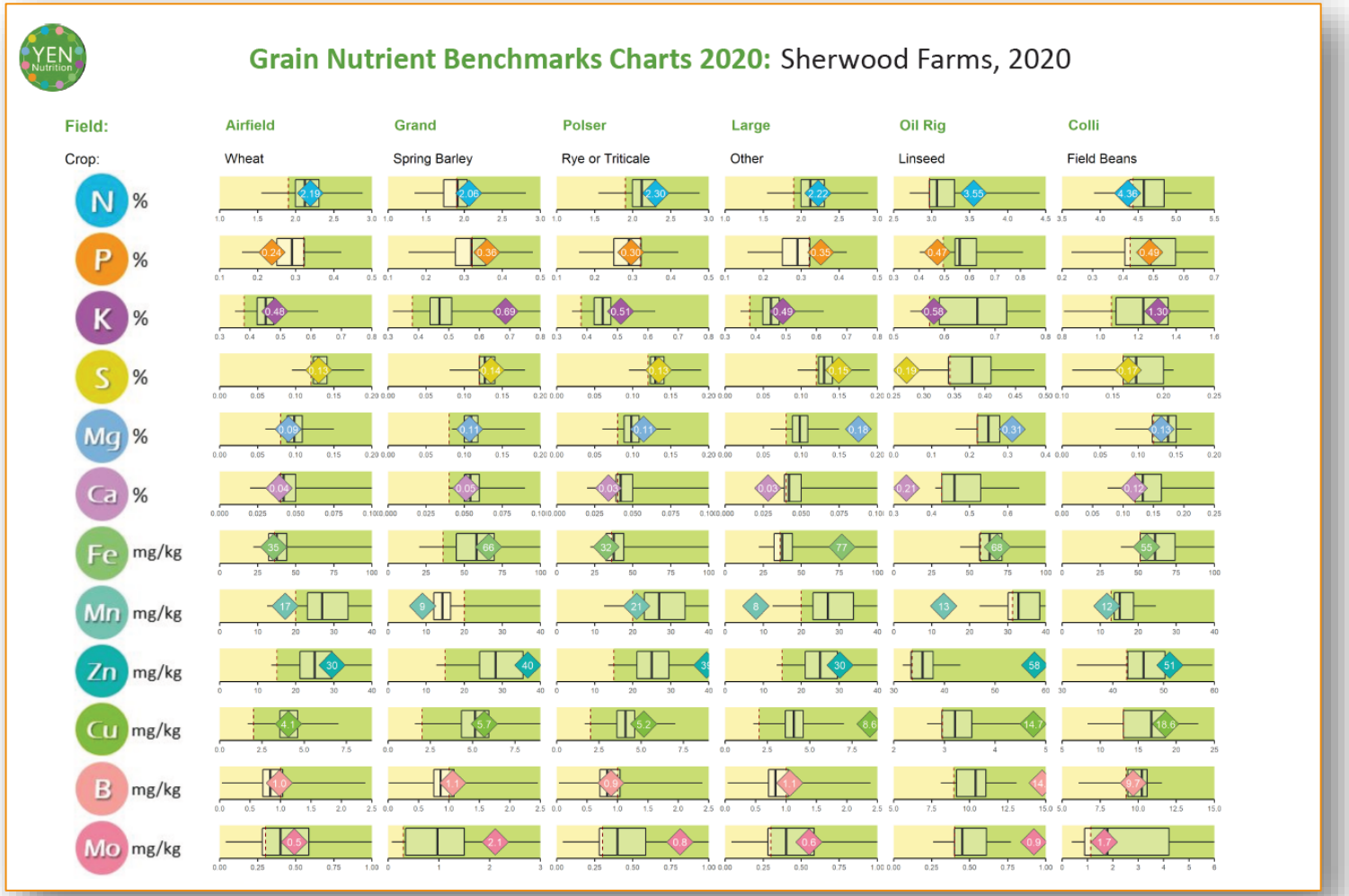
YEN Nutrition
- Service to benchmark grain nutrients

Benchmark crops for 12 Nutrients

- Shared soil & input data to learn together
- Know your nutrition, identify deficiencies
- Calculate Offtakes & Nutrient Balances

Find out more at www.yen.adas.co.uk

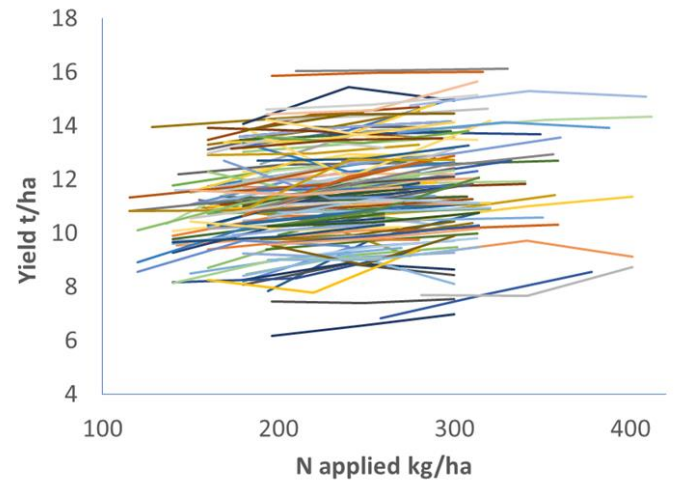
Launching **Crop Nutrition Clubs** to discuss results and test rates & solutions on-farm

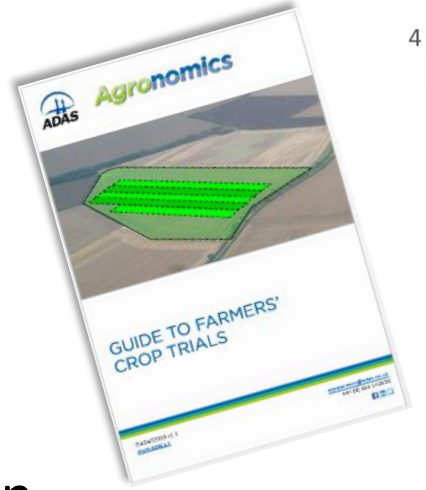


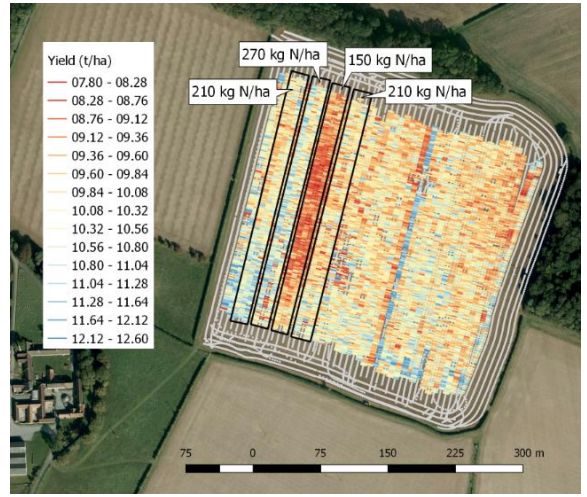
Test N decisions on farm – tramline trials

AHDB **LearN** Project 2014-2017 demonstrated the value of on-farm comparisons

- Simple tests of +/- 60 kg N/ha on alternate tramlines
- Obtained yields from yield maps … & protein
- Overall LearN farmers getting N about right







- With reduced N rates, treatment comparisons can give useful visual indications of N status
- Developing tools to support the management of on-farm trials in Farm-PEP project

Sensing & testing in season

Lots of sensors & technologies provide relevant data

- How to integrate into N decision making?

In early spring – the crop an assay of available soil N?

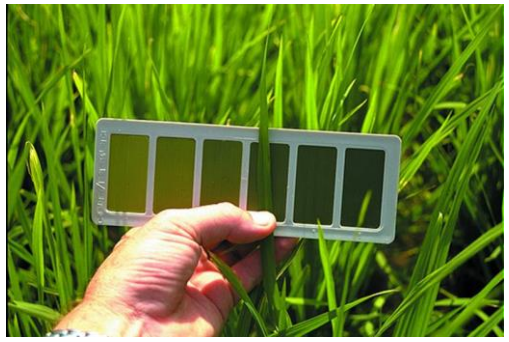
- Account for crop N – could be worth £300/ha in OSR!

Later – use sensors to check N status

- where are we on shoulder of the curve?

Visual check - simple approach can be effective

… Especially if combined with high / low strips



RHIZA
Hummingbird Technologies
Omnia Precision Agronomy
fieldmargin
Precision Decisions
PHIELD TEK
soilessentials precision farming solutions
DATA FARMING

Measuring and accounting for Crop N

Each unit of Green Area Index in OSR contains 50kg N/ha

- That N is in the crop & doesn't need to come from fert
  - Even if frosted off … though not if taken by pigeons!
  - Many OSR crops already contain £300/ha worth of N!

How to measure GAI / N uptake?

Digital photo for GAIs of up to 2.5

- Use phone apps e.g. the BASF GAI Tool app

Crop fresh weight for GAIs above 2.5

- Record fresh weight in kg of 1m x 1m area
- Multiply by 0.8 to give GAI

Fraction of soil covered by crop

Ground cover	GAI	Kg N/ha
1/3	0.5	25
½	1.0	20
¾	2.0	100

Absolute Calibrations from Sensors

Consider using N efficiency products

Department for Environment Food & Rural Affairs

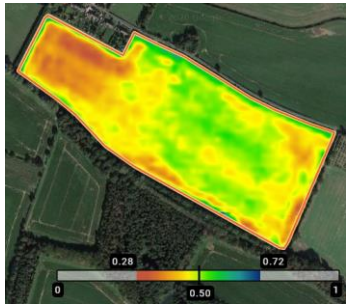
ADAS

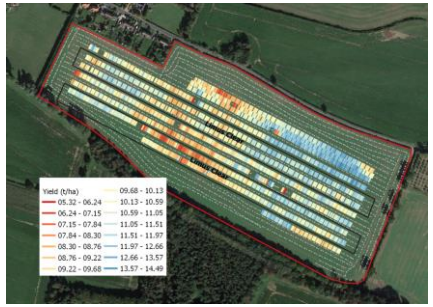
Type	Effect	Active Ingredients	Example Products
Nitrification Inhibitors	Slow conversion ammonium to nitrate Reduce N_2O emissions Can reduce nitrate leaching	2-chloro-6-(trichloromethyl-pyridine) Dicyandiamide (DCD) 3,4-dimethylpyrazole	**N-Lock® -** Corteva **Didin –** Omex **ENTEC®** - Origin **Vizura®** - BASF
Urease Inhibitors	Slow conversion urea to ammonium **Reduce Ammonia losses** **Improve efficiency of urea & UAN**	nBTPT 1,2,4-triazole (2-NPT) NBTPT & NPPT	**SUSTAIN®** (**Agrotain®**) – Origin **YaraVera Amiplus® -** Yara **Piagran Pro® -** SKW Piesteritz **Limus®** BASF
NI & UI	As above	MPA & 2-NPT DCD & ammonium thiosulphate	**Alzon-neo-N®** SKW Piesteritz **Didin®** - Omex
Slow or Control release	Physical or chemical barriers to release of nitrogen	Polymer Coated Polymers	**Nutrisphere® , Origin Enhanced-N®** **Efficie-N-t 28® Agrovital**

Also wide range of Biostimulants, Microbial and Foliar products – Recommend you test on-farm before committing

Defra review into Enhanced Efficiency Fertilisers – reporting spring 2022

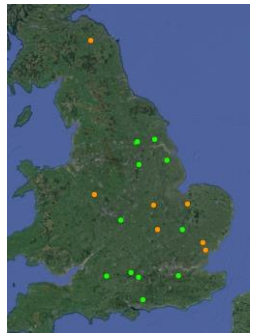
On-farm Urease Inhibitor trials on Urea & UAN

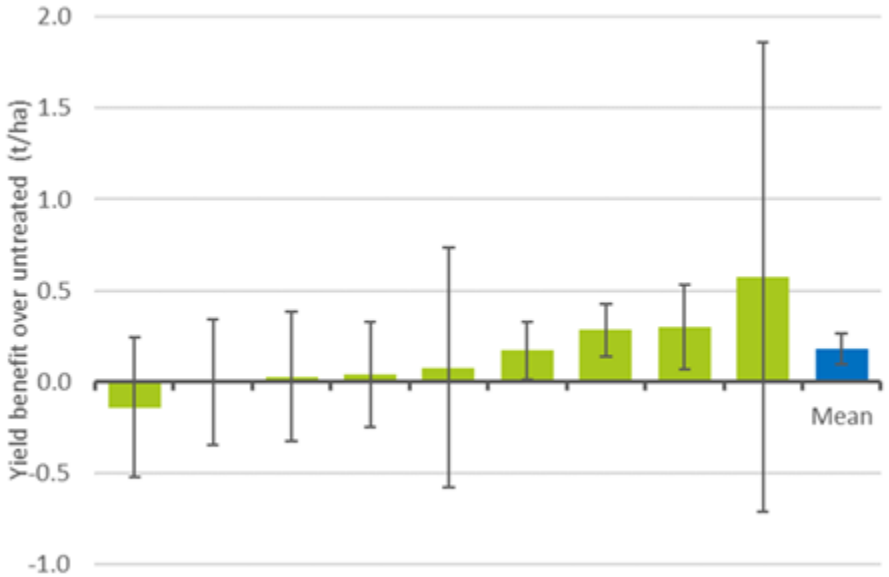




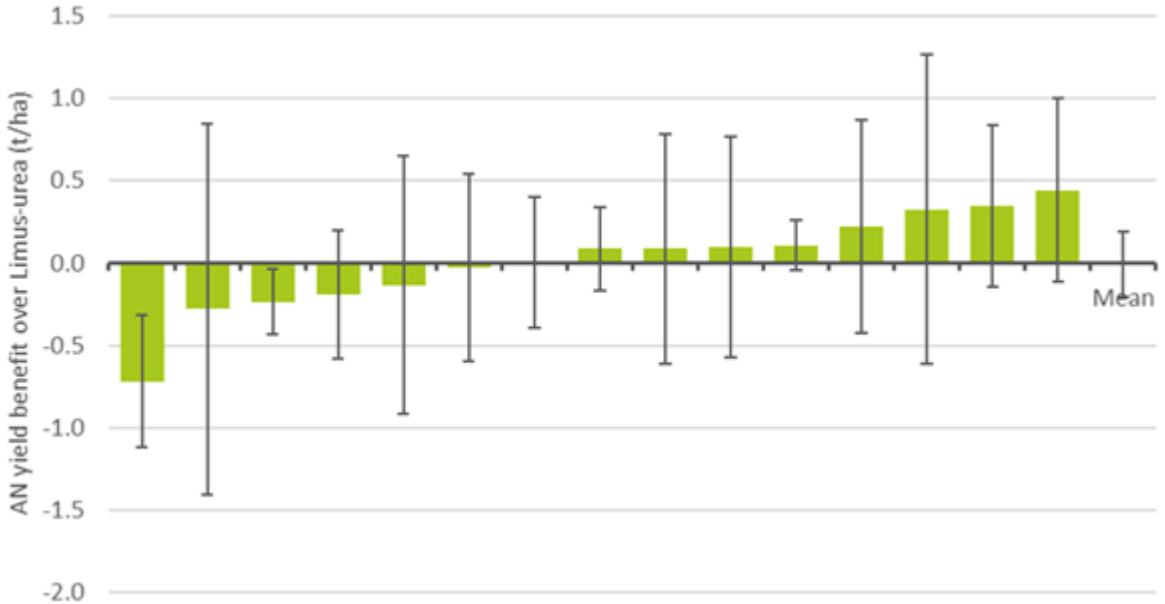
BASF study of Limus on 9 UAN trials and 15 urea trials from 2019 to 2021

- Using farmers Line Trials
- analysed by ADAS Agronomics





With UAN Limus Clear increased yield by 0.16 t/ha ± 0.10



Limus-urea gave equivalent yields to AN (+0.02 t/ha ± 0.16)

Reframing our attitude to N rates?

Consider the return on investment from the last 10, 20, 30, 40 kg N /ha.

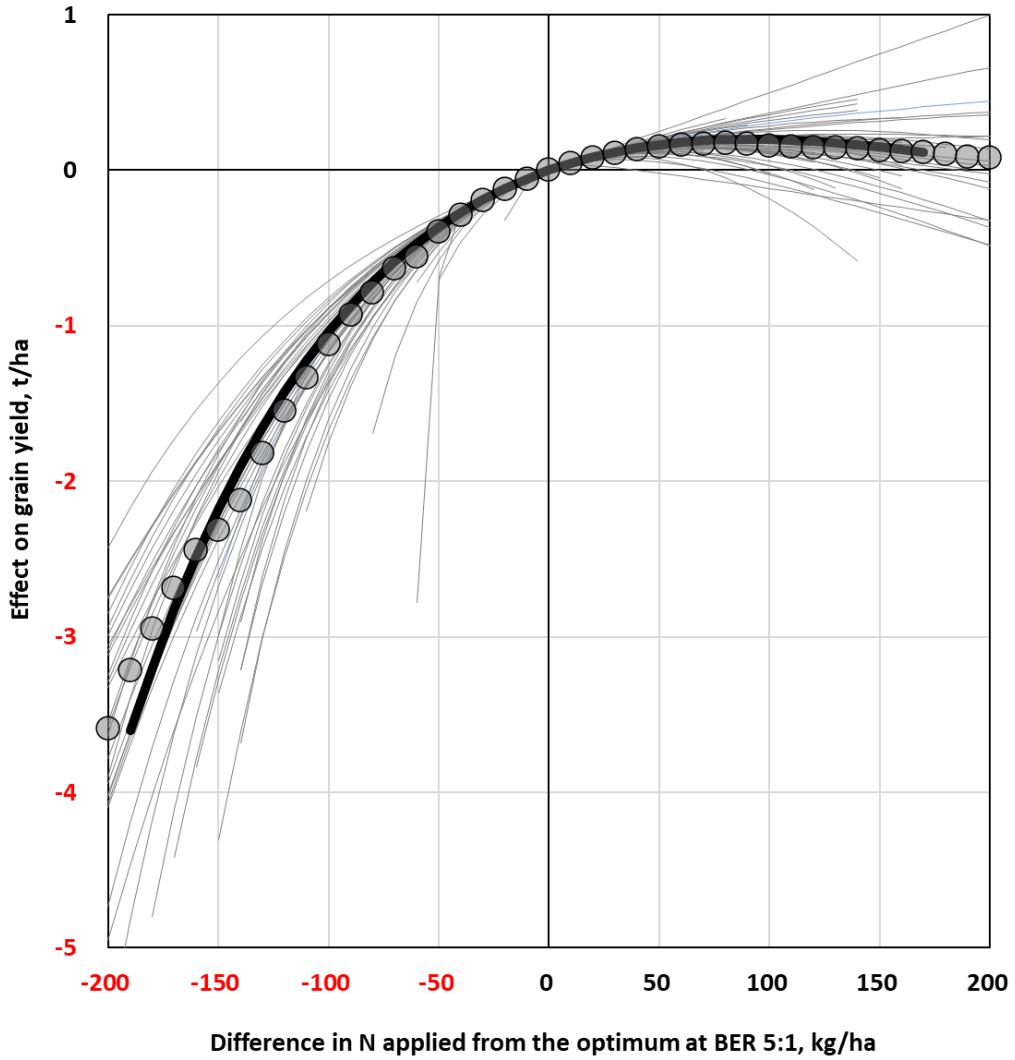
- No question about the value of the first 100 kg N/ha
  - Increases yield by ~2-4 t/ha

Appreciate the flatness of the response curve

- differences in yield and gross margin from applying 50kg N/ha more or less are modest

Value from final portion of fertilizer N at 'old' prices:

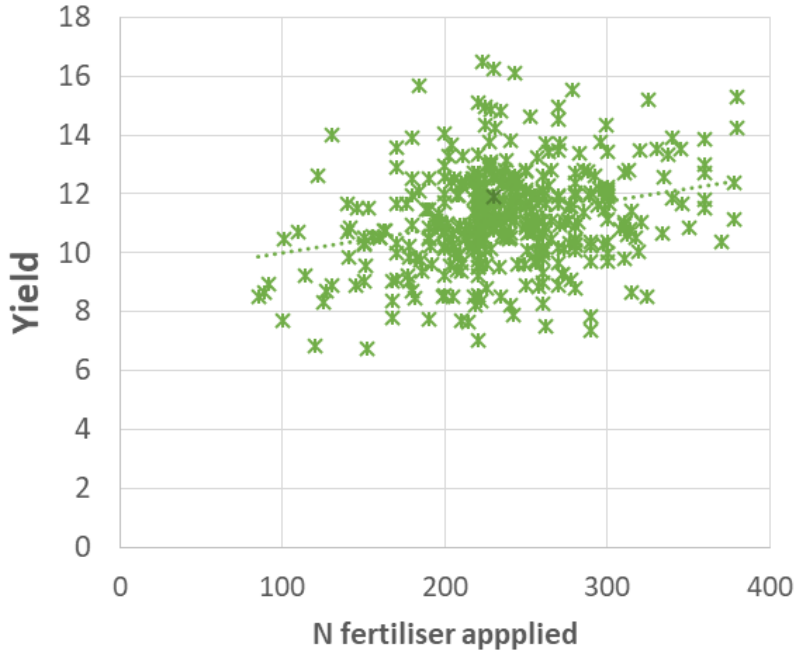
Final portion Kg N/ha	Yield gained t/ha	N cost £/ha	Yield value gained £/ha	Increased margin £/ha
10	0.06	£7	£8	£0.69
20	0.12	£14	£17	£2.93
30	0.19	£22	£28	£6.87
40	0.28	£29	£42	£12.69



Conclusions

Don’t be too afraid to cut N rates back

- Applying high N rates isn’t what gives high yields
  - Variation in yield mostly not due to variability in N applied
- Use a range of tools to assess whether past N rates were right
  - Grain Analysis – YEN Nutrition
  - Experiment on-farm
- At lower N rates more care needed to track N status
  - Value from sensing tools … & visual comparisons
- Pressure from high N fertiliser price requires same solutions as responding to its high carbon / GHG price



Thank you … Questions?

Get involved in Crop Nutrition Clubs -

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www.yen.adas.co.uk www.farmpep.net