Nitrogen

- **What Nitrogen Products Do You Use?**
  - Bagged Fertiliser
  - Organic Manures
  - Other Wastes – digestates & composts
  - Clover & other nitrogen fixing crops

Nitrogen

- Yield driver
- Key in chlorophyll production and protein (amino acid) synthesis.
- Deficiency symptoms – pale older leaves and stunted growth.

Supplied to plant as;

- Nitrate (NO_3) most readily form taken up by plant.

- Ammonium NH_4 converted by soil microbes to nitrate NO_3 (nitrification).

- Urea (NH_2) convert to NH_4 (soil enzymes) then NO_3 some lost to environment as NH_3 (volatilisation).

  Loss greater on high pH soils >6.5 and also dry warm conditions.

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Nitrogen Cycle

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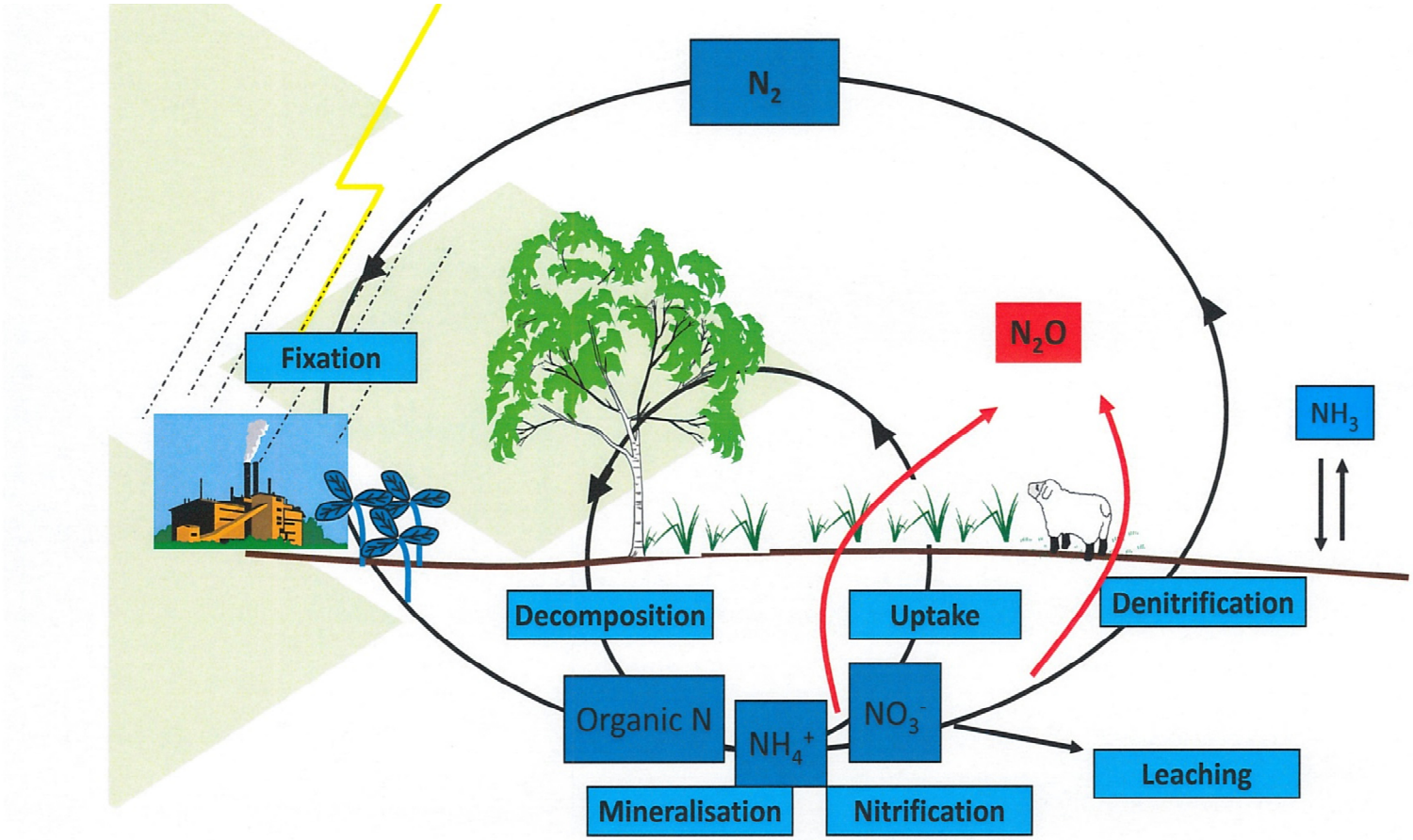

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Crop Nitrogen Demand

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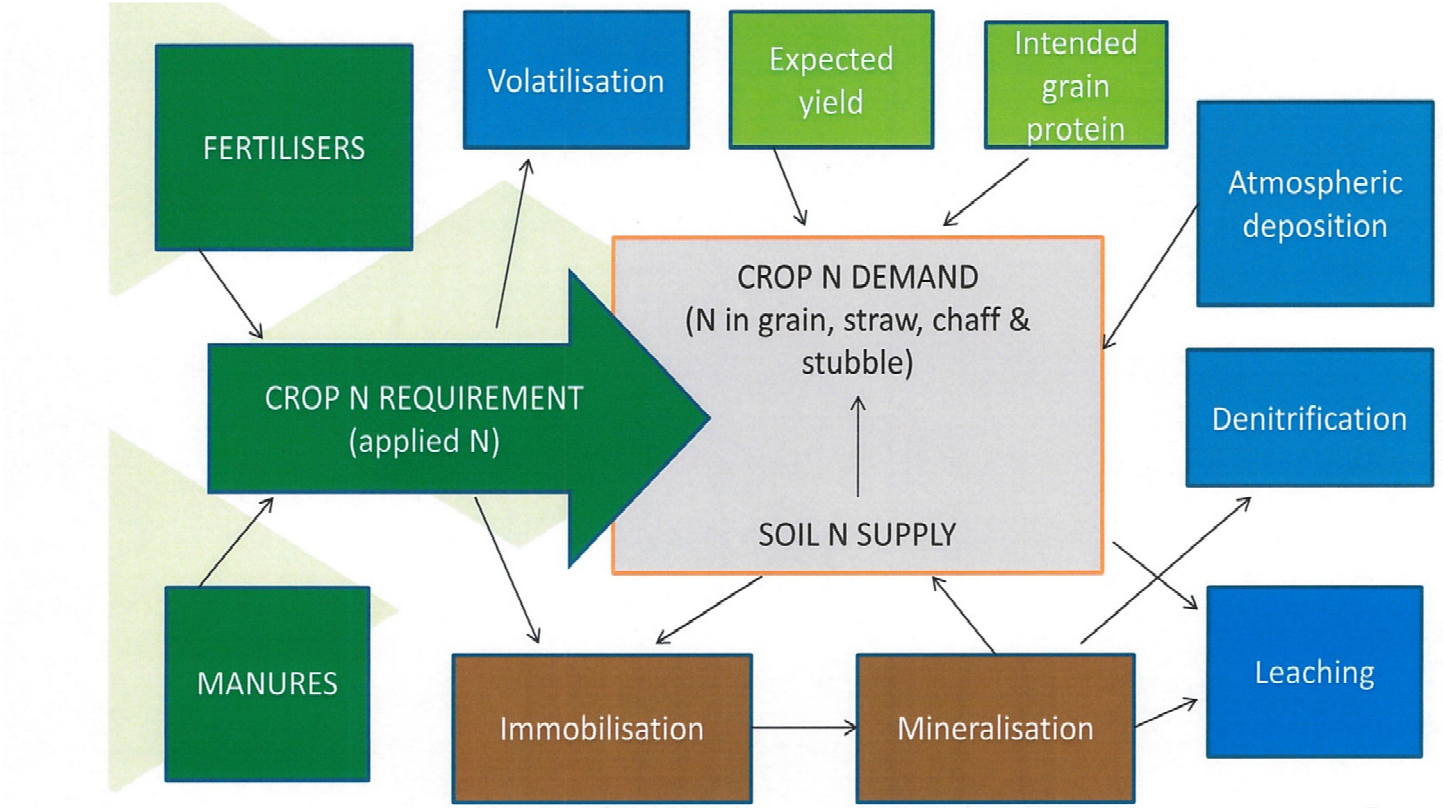

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Sulphur & Nitrogen Link

- Crops and grassland getting higher levels of applied nitrogen require sulphur to effectively utilise the available nitrogen
- Deficiency symptoms – pale younger leaves & stunted crop in cereals.
- Deficiency more likely on sandy, shallow or soils low in organic matter.
- Analysis helps to identify high risk soils (low or v. low status) but not definitive

Confirm by tissue analysis, N:S ratio when >16:1

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Sulphur & Nitrogen Link

- Supplied as elemental sulphur (slow release) or in readily available sulphate form in fertilisers e.g. ammonium sulphate.
- Winter Cereals 50kg/ha, Spring cereals 10-20kg/ha
- Grass 40kg/ha per season or per cut 2nd cut at greater risk
- Apply in spring as main uptake by roots with little taken up by leaf (2%)
- Muck and slurry are useful sources of sulphur

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Fertiliser Requirements - Nitrogen Response Curve

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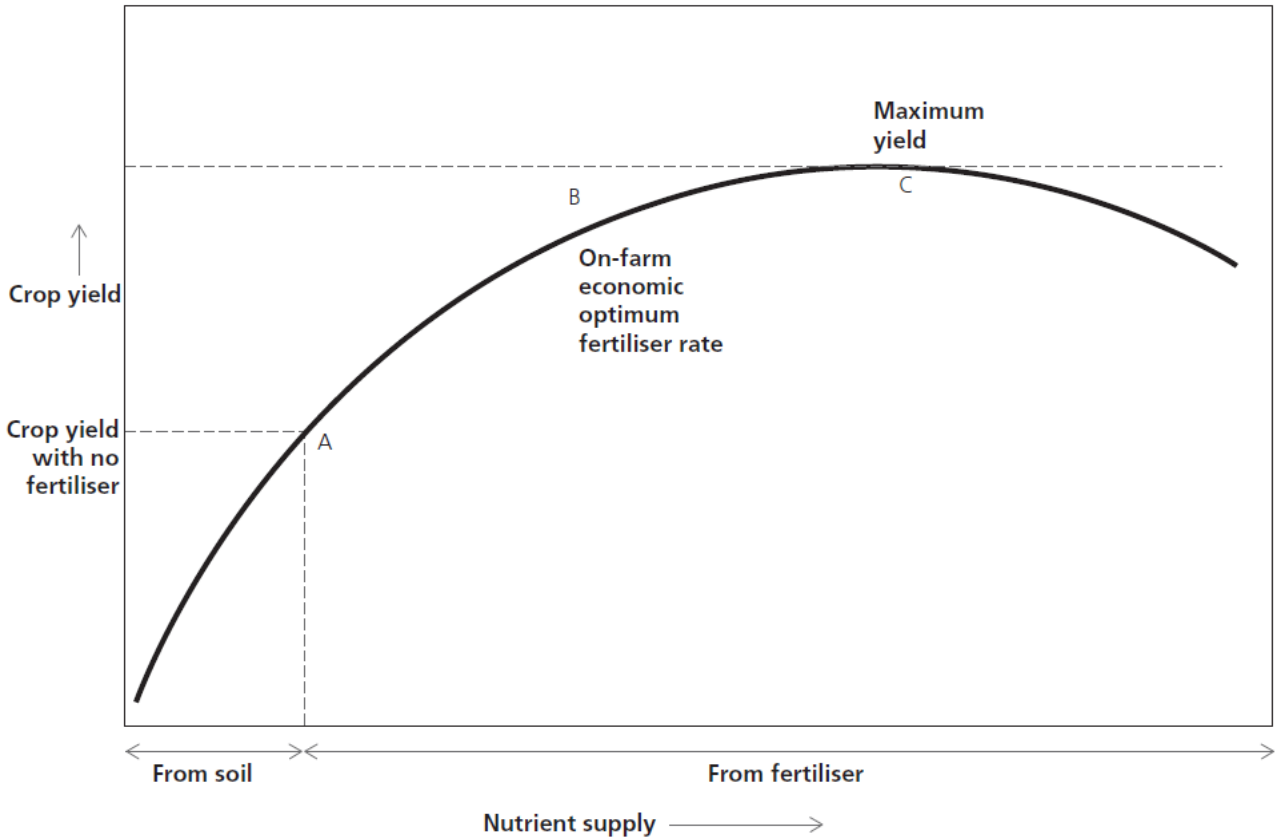

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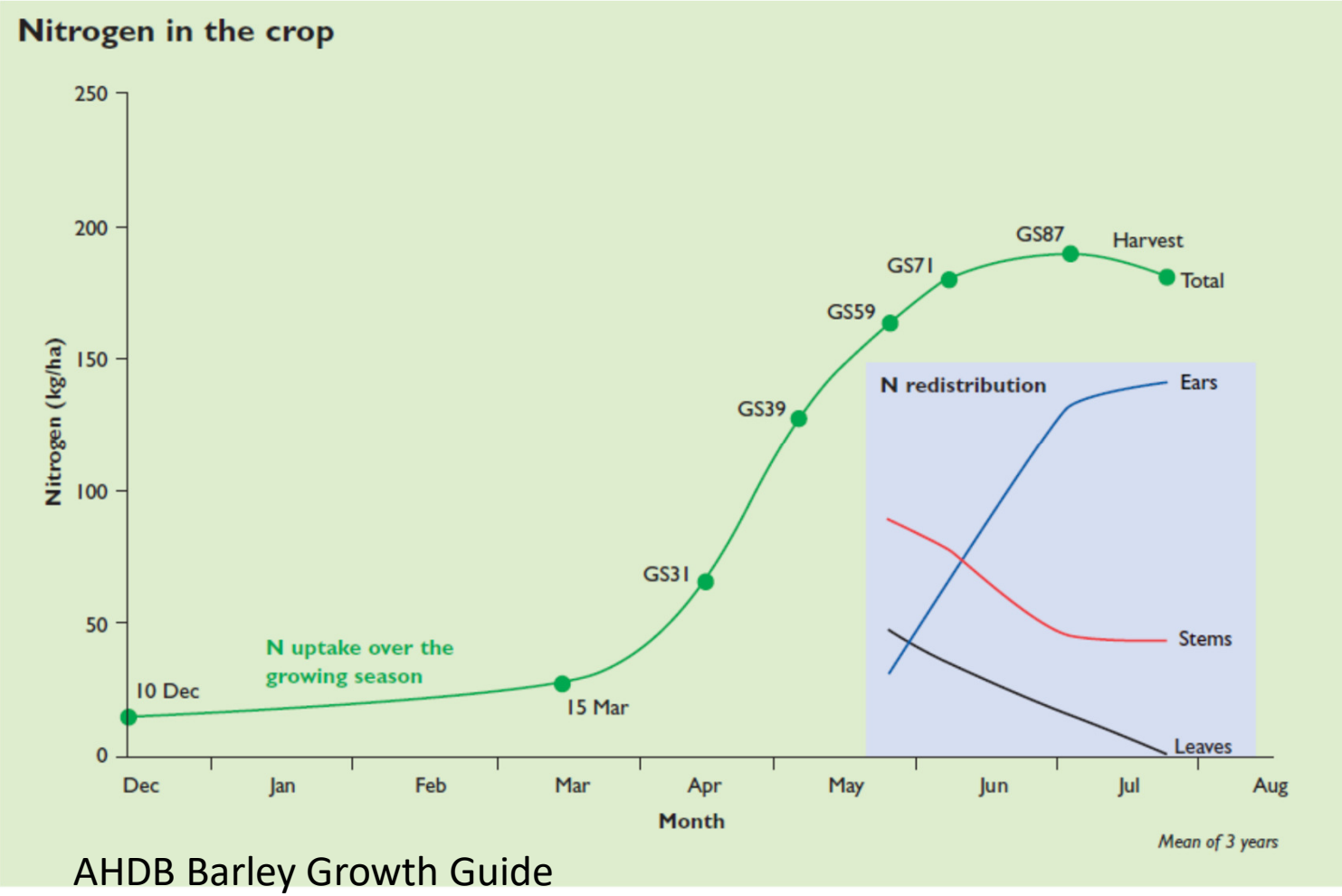
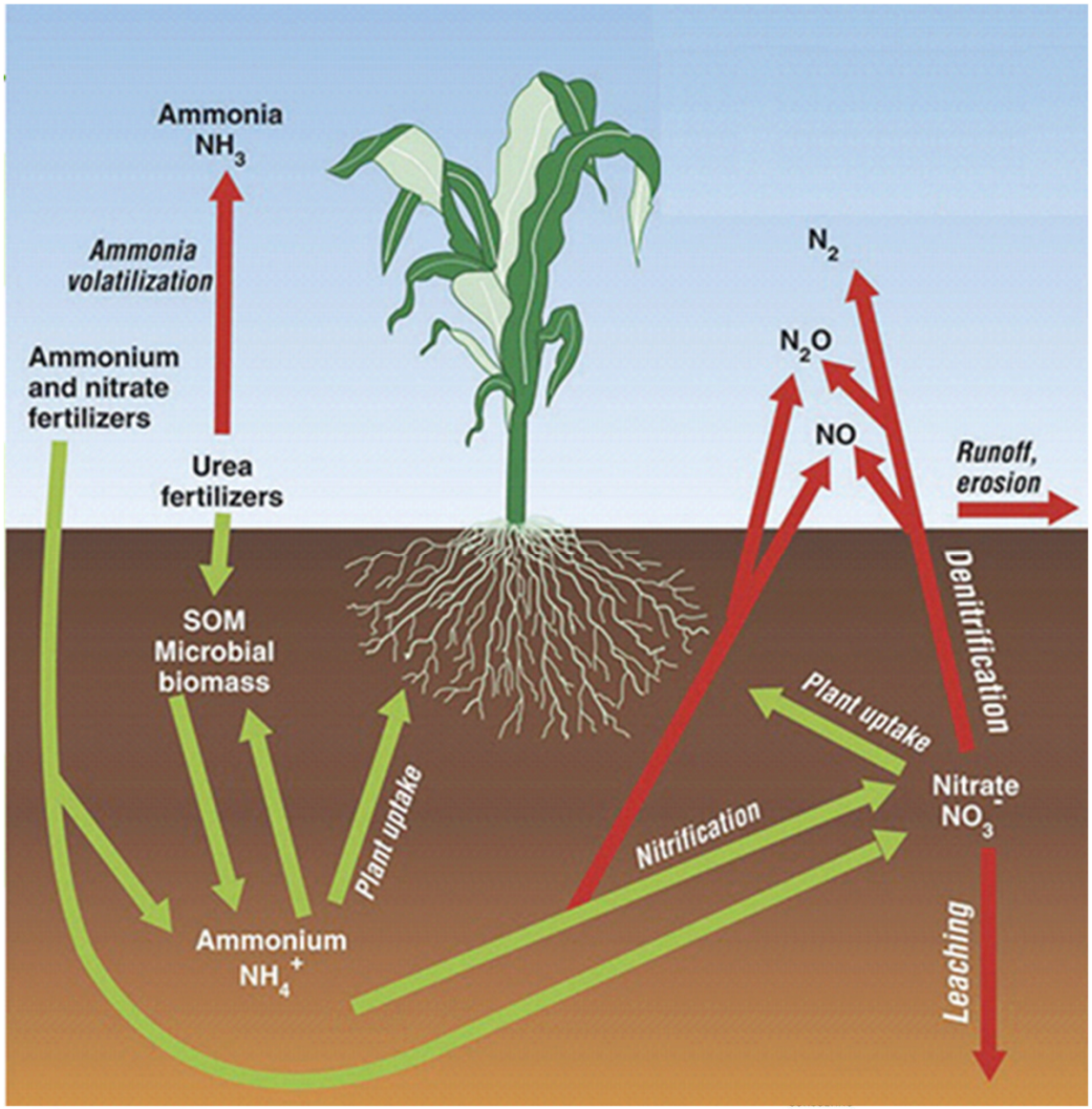
Crop N demand



AHDB Barley Growth Guide

N availability in soil



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Aim: to ensure N is available to the crop when demand is greatest, but minimise losses

- Fertilizer type
- Timing
- Formulation

Immobilization accounts for 30-40% reduction in fertilizer availability

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Crop Requirement

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Crop requirement for sandy loan/mineral soil

Crop	kgN/ha	Units/acre (kgN/ha x 0.8)
S Barley	130	104
W Barley	180	144
W Wheat	200	160

- Adjust for
  - Previous crop residue
  - Muck & slurry
  - Higher yield
  - Other soil type

See SRUC Technical Note TN652
Nitrogen recommendations for cereals, oilseed rape & potatoes

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Grassland Requirement

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Depends how you are managing

Cutting	kgN/ha	Units/acre
Silage 1st cut	120	96
Silage 2nd cut	90	72

Grazing	kgN/ha	Units/acre
Organic, low intensity, high clover	Nil	Nil
1 application/season	60 - 90	48 - 72
2 application/season	90 - 190	72 - 152
3 or more	190 - 240	152 - 192

- Adjust for residues, muck/slurry

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Organic Manures:

- Organic manures contain varying amounts of nitrogen
- Not all readily available nitrogen (RAN)
- The rest is broken down over time

Organic Fertiliser	Total kgN/ton Std book value
Cattle FYM	6
Layer manure	19
Cattle slurry	2.6
Pig slurry	3.6
Digestate	5
Green waste	7.5

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Readily Available N i.e. Ammonium-N, Nitrate-N, (Uric-N for poultry manures) by analysis - is *potentially* available for rapid crop uptake

Organic N is broken down slowly to become available over months or years

Crop Available N is the readily available N left for crop uptake after losses are taken into account

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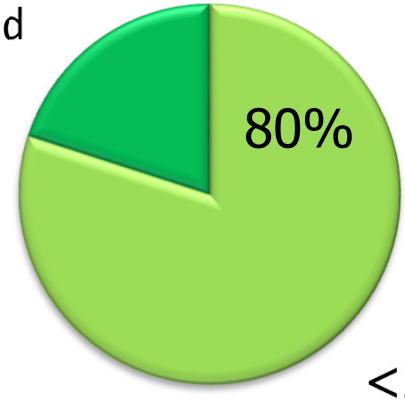
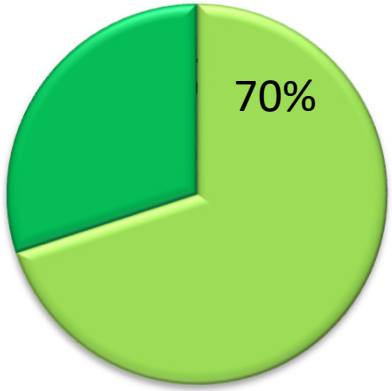
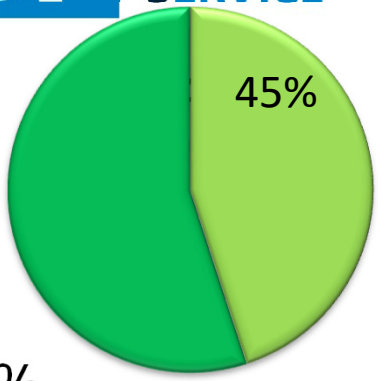
Food based digestate



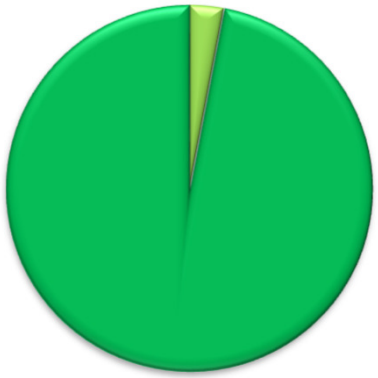
Pig slurry



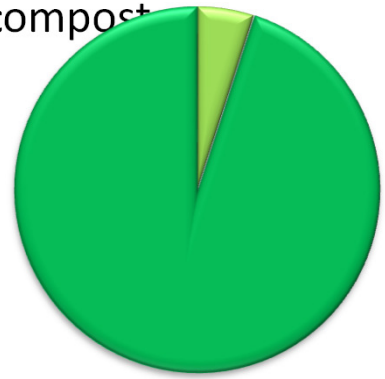
Cattle slurry



Green compost



Green/food compost



High readily available N >30% total N (NVZs)

RAN **Organic N**

Readily available N (RAN) content of food-based digestate based on 250 kg N/ha

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Factors affecting crop-available N

- Rainfall
- Soil type, soil depth and drainage
- Timing of application (spring or autumn)
- Method of application (surface, dribble bar, injection and whether ploughed down
- Use SRUC Technical Note no. 650
- MANNER NPK www.planet4farmers.co.uk/manner to calculate crop-available N.

Important to test the bulky organic materials that you use often (slurries, dung etc.)

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- Don't just guess!
- By testing you can be sure you are getting crop fertiliser applications right and are not over or under applying N:P:K
- Ensure you obtain a representative sample.
  - For solids, take multiple sub-samples from various parts (locations, heights and depths) of the pile
  - For liquids, agitate thoroughly, or (much less ideal) take multiple samples from different depths within the tank.

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Nitrogen Trials by SRUC Research

- Nitrogen Use Efficiency
- Nitrogen Timing

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Comparing NUE of spring oats and barley

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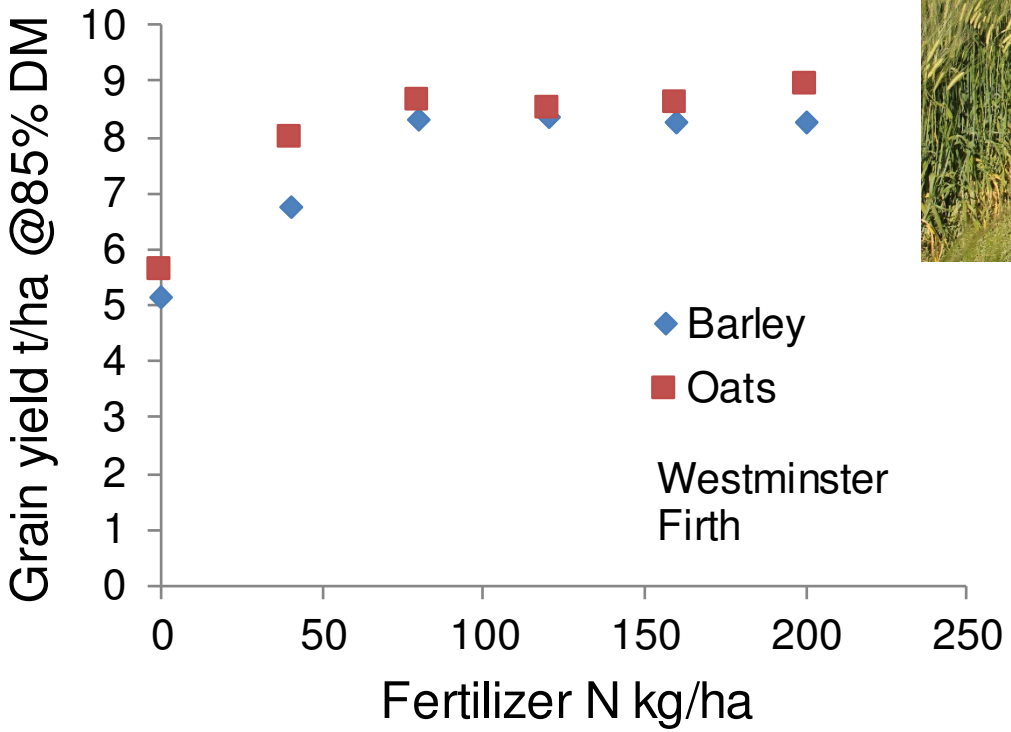
Fertiliser recommendations
30 kg/ha less for oats than feed barley



Oats are better at scavenging nitrogen from the soil.
Not related to greater rooting depth

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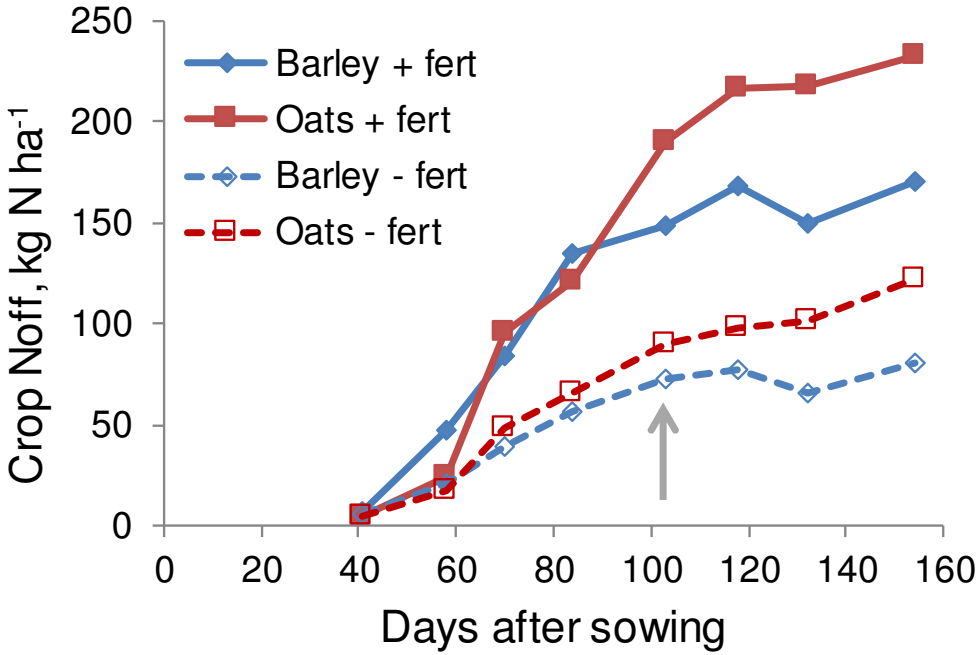

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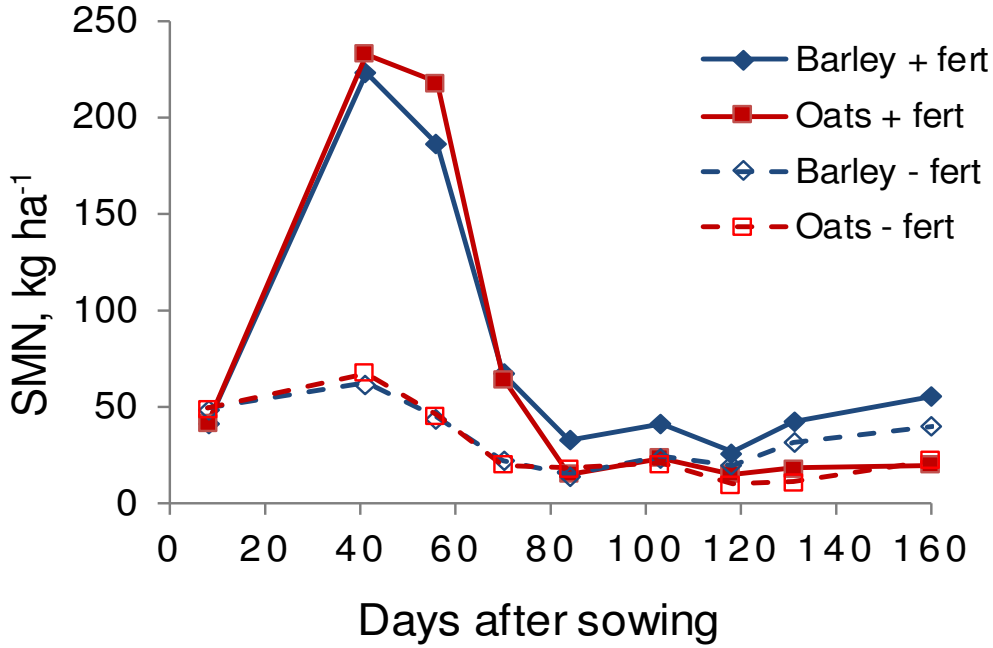
130 kg N/ha

0 kg N/ha

N capture



Soil & fertiliser N depletion 0-60 cm

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Nitrogen Timing
Trial Site East Lothian

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N rates: 0-360 kg N

N timing:

Total N rate (kg/ha)	1st N timing Seed bed	2nd N timing GS13-15	3rd N timing GS37-39	SO3 Seed bed (kg/ha)	Treatment Name
120	120	0	0	40	Seedbed
120	40	80	0	40	Early
120	0	120	0	40	Medium
120	40	40	40	40	Late

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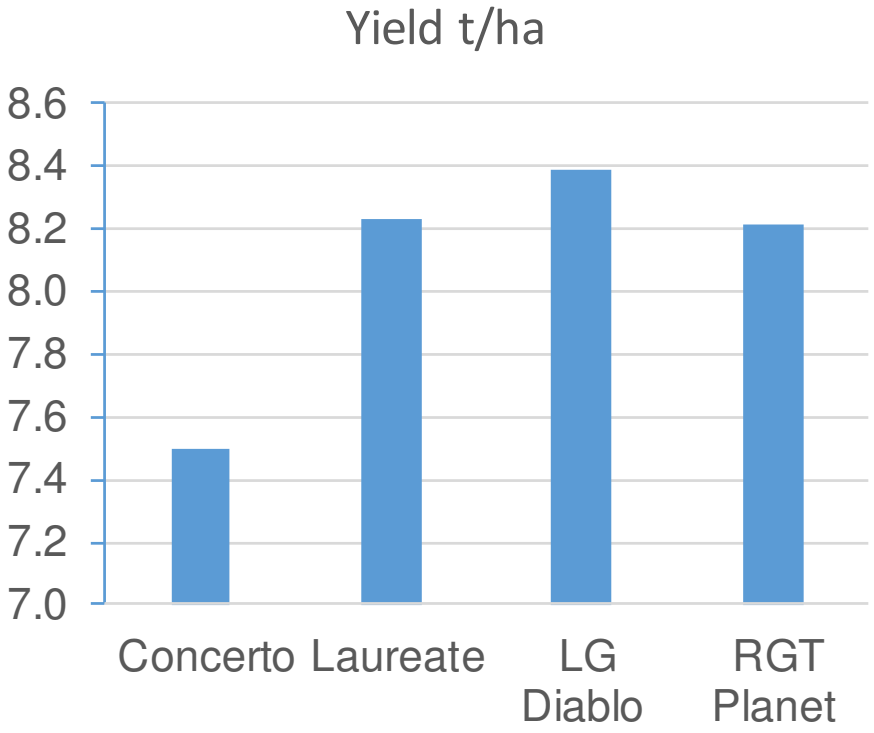
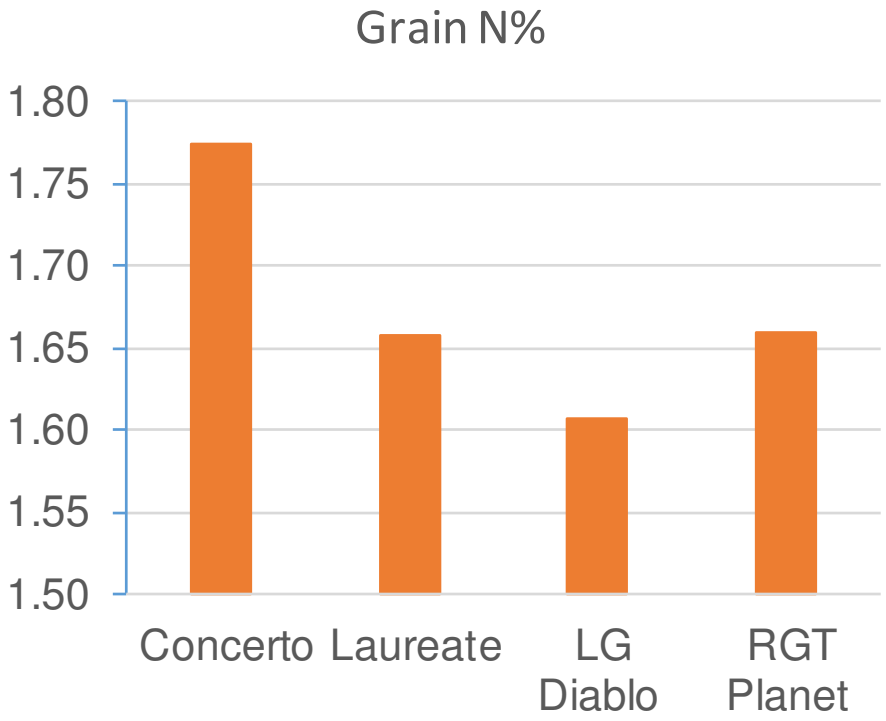
Effects of N timing

Treatment	Yield t/ha	Grain N%	NUpE, kg/kg	Grain Noff, kg
Seedbed	7.83	1.65	0.69	151
Early	8.94	1.67	0.79	176
Medium	7.16	1.71	0.65	144
Late	8.40	1.67	0.74	165
Trt	0.03	0.01	0.05	0.03
Var	<0.001	<0.001	0.55	0.56
Trt*Var	0.78	0.19	0.63	0.40
lsd	1.065	0.030	0.094	19.99

Variety yield & grain N%





Trial Conclusions

Estimating N fertiliser requirement is inherently uncertain as crop N use efficiency varies with site, season and crop management

Stabilised fertiliser products can significantly reduce N losses but have smaller effects on crop NUE

Species differ in NUE and can provide targets for improvement by breeding

Applying some N to seed bed can increase N uptake efficiency of spring barley in some seasons

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Stabilised N Fertiliser

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Stabilised Products feature

- Urease Inhibitor

or

- Nitrification Inhibitor

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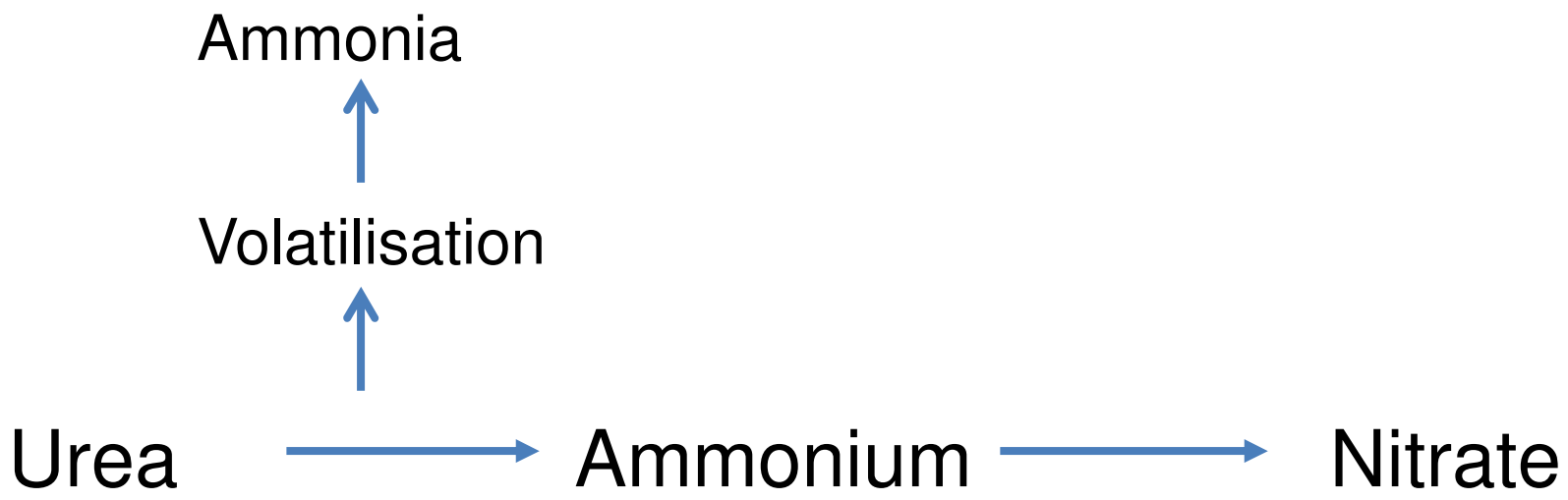
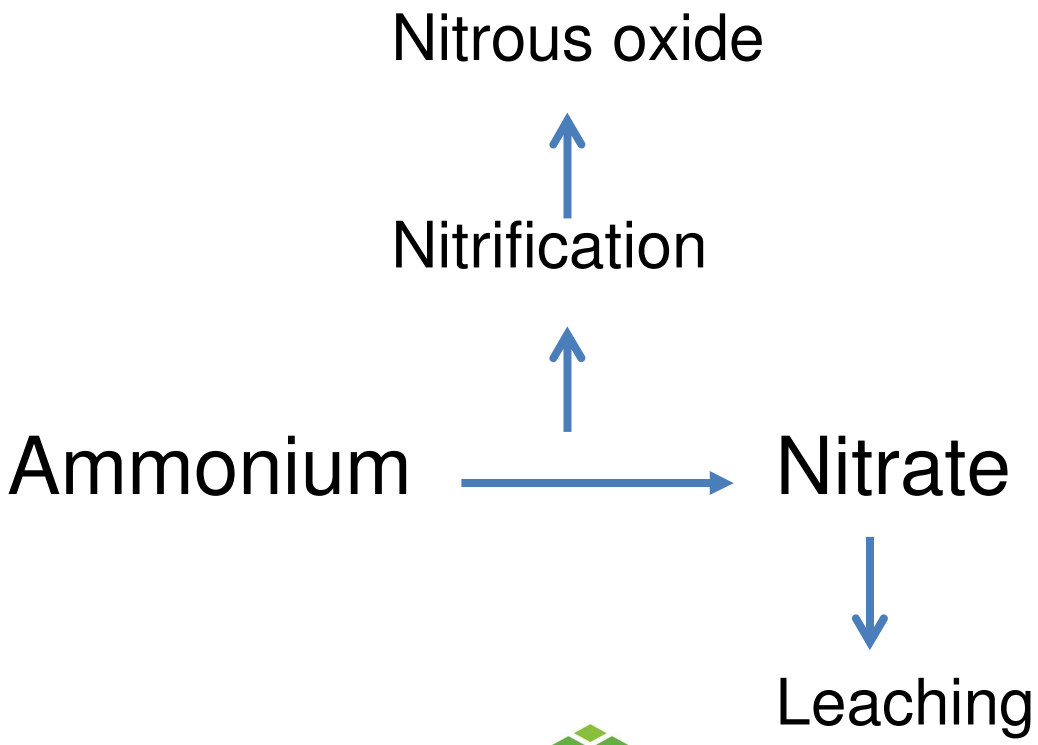
Stabilised Fertiliser

- Urease Inhibitor



Stabilised Fertiliser

- Nitrification Inhibitor



Effect of Nitrogen Inhibitors

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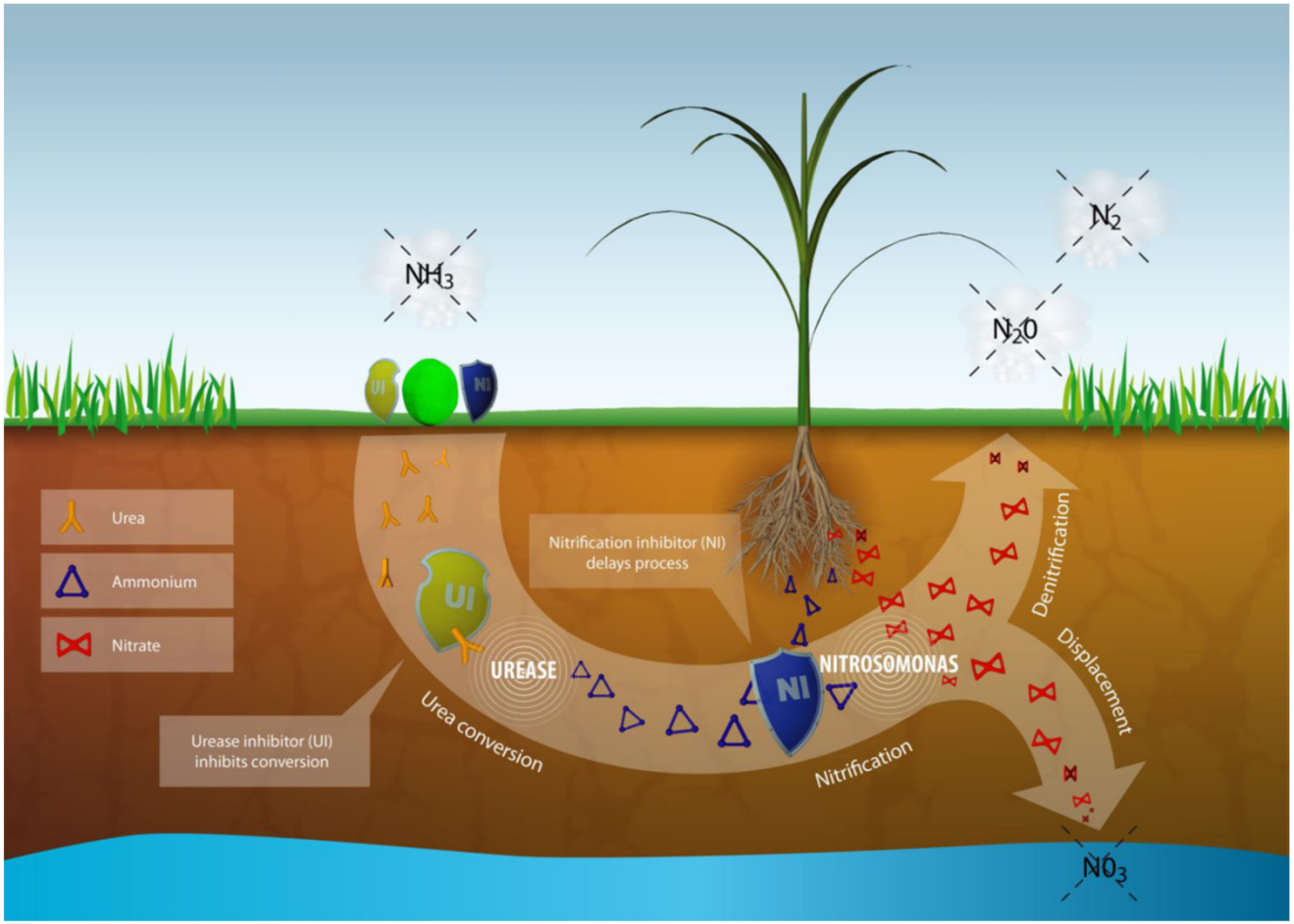

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Differences: Urease- and Nitrification Inhibitors

	Urease Inhibitor	Nitrification Inhibitor
Effect	Slows down the conversion of urea to ammonium	Slows down the conversion of ammonium to nitrate
Time	1-2 weeks	6-10 weeks
Reduces	Ammonia emissions	N_2O, N_2, NO_x, NO_3
Advantage	Drought and high temperature tolerance, Higher N efficiency, Reduced carbon footprint	Higher N efficiency, reduces application no, lower risks after fertilisation.

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Alzon Neo-N: Inhibited Urea

Urease inhibitor (2-NPT)

Nitrification inhibitor (MPA)

Conclusion

- Nitrification inhibitor, reducing nitrous oxide emissions. Works well with ammonium based fertilisers in arable soils

- Urease inhibitors reduce ammonia emissions

- Yield effects small or non-existent and will be offset to some extent by more efficient N use

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- Good nitrogen management
  - reduces losses into environment
  - improves efficiency of crop response to available nitrogen
  - good for profit
  - reduces greenhouse gas emissions

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GHG Emissions

Five main sources of Agri emissions:

1. Fuel – combustion carbon dioxide
2. Livestock – ruminants produce methane
3. Soils – nitrous oxide and carbon dioxide
4. **Nitrogen fertiliser manure and slurry - nitrous oxide**
5. Cropland conversion – release of carbon from grassland when ploughed

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GHG Emissions

The 3 gases have different impacts

Expressed as carbon dioxide equivalents (**CO2e**)

- Carbon Dioxide =1 CO2e

- Methane = 25 CO2e

- **Nitrous Oxide = 298 CO2e**

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Fertiliser Spreader Testing

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Tray Testing of Spreaders

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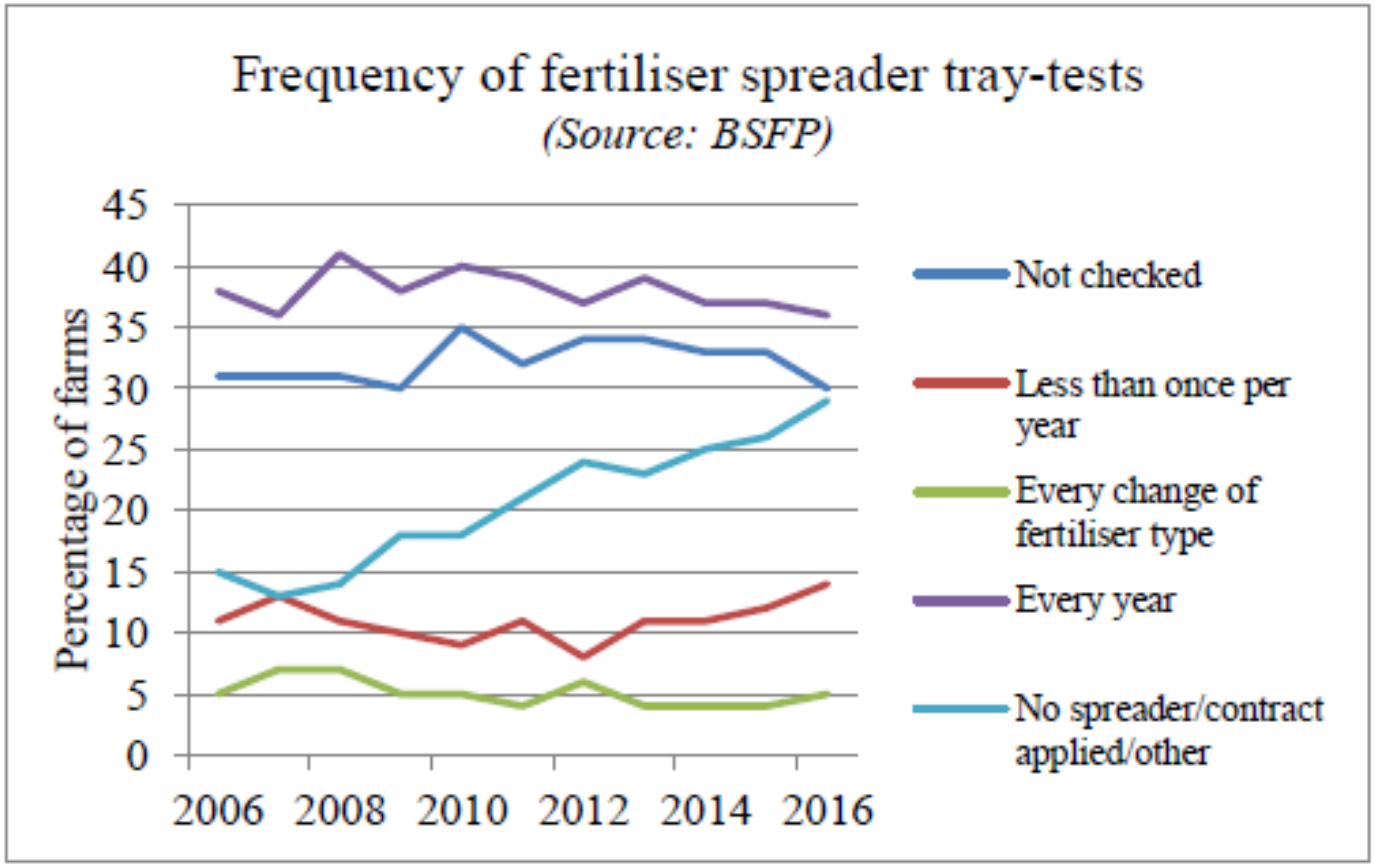

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Why Test?

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- Uneven spreading of nitrogen affects crop yield and quality
- Coefficient of Variation (CV) measures the accuracy of the spread pattern
- For fertilisers, a CV of 15% should be attainable in field conditions

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Why Test?

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Coefficient of Variation	Rating
< 10%	Excellent
10-15%	Good
15-20%	Poor
> 20%	Unacceptable

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Why Test?

- At current prices, the loss of margin at a CV of 25% (often found before testing) against and achievable CV of 5% is around £20/ha in wheat and winter oilseed rape

- The cost of a professional tray test would be recouped over 12 ha

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Prior to the Test

- Provided the following information to the testing company:

  - Address and contact details of the farm
  - Make and model of spreader
  - Width at which the machine needs to be tested at
  - Number of products which require testing through the machine

Fertiliser Product Testing

Four characteristics that will affect the way fertiliser spreads:

- Shape of material
- Size of material
- Strength of material
- Weight of material

Can't test the shape of the material, but the other three factors can be tested

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Fertiliser Product Testing

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Alzon was the product tested at Girrick

- Weight a litre tube to get bulk density
- Size of material determined using a grader box
- Strength tester used to determine the strength of the product (10 granules per sample)

Product Data						
Fertiliser	MSP Alzon 40N 10S					
Density (Kg/L)	0.78	Batch No.	N/A			
Strength (Kg/Force)	6	5	8	7	6	Av.
	9	6	9	4	4	6.4
Lumping in Bag	No	Residue on Vanes		No		

Grader Box

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Spreader Checklist

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Checklist	State	Notes
Guards, inc. PTO Guard - complete and correct	Passed	
Security of spreader mounting points	Passed	
Condition of hopper lid/cover	Passed	
Structural condition inc. hopper	Passed	
Grids/screens inside hopper	Passed	
Agitation - intact and working correctly	Passed	
Metering system ON/OFF	Passed	
Hydraulic system free from leaks	Not Fitted	
Drive shafts in good condition, inc. bushes and bearings	Passed	
Gearbox(es) in good conditions	Passed	
Discs in good condition and attached securely and correctly	Passed	
Vanes in good condition and attached securely and correctly	Passed	changed.
Discs and vanes timed correctly	Passed	
Shutter apertures equal both sides	Passed	
Drop on guides complete and correct	Passed	
Headland spreading system intact and working correctly	Passed	
Measure disc speed/PTO speed	Passed	
Hopper capacity	2500	
Border device	Trend	
Hectares per annum	800	
Parts supplied	No	
NSTS Pass or Fail	Pass	

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Tray Test

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Tray Test

- Trays are laid out at 1m intervals
- At half way point, where overlap kicks in, you have two touching trays
- Both touching trays emptied into same tube, then trays beyond this are emptied into tubes back towards the centre to simulate another pass

Tray Test Results

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10.5m 0m 10.5m

10.5m 0m 10.5m

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Tray Test Results

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- The CV attained on the first run at Girrick was 11.75% (good)
- This was reduced by 3.17% for the final run, which attained a CV of 8.58% (excellent)
- For straight Nitrogen based products with wheat at £140/t, reducing your CV by 3.17% could save £2.80/ha

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The Bigger Picture

- A properly maintained set up and operated fertiliser spreader used over 100 ha in one year will apply fertiliser worth some £10,000, generating additional crop yield worth around £80,000

- It makes good sense to spend less than £250 to ensure that the spreader is properly set up

- Tests can be organised through the National Spreader Testing Scheme (www.nsts.org.uk)

- In practice, most test are carried out by Spreader and Sprayer Testing Ltd (SCS) which offers national coverage

- SCS also offers tray testing kits for those who would prefer to carry out their own tests

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- Ideally, every fertiliser spreader should be tray tested at least annually

- Professional tray testing is usually worth it – cost can be recouped over quite a small area of crop

- If you're committed and conscientious, equipment can be bought to do tray testing yourself!

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Thank you for listening

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