Nitrogen decisions this spring – make every kg count!

- **Winter rainfall up to 18 March has generally been higher than the long term average. This means that leaching of soil N residues that were left in the soil last autumn is likely to have been higher than normal.**
- **Reports of soil N are variable but are typically average or lower than average. Where any nitrogen has been applied this spring (as bag fertiliser or organic manure) it is now too late to take samples for soil mineral N (SMN) analysis.**
- **When assessing the soil N supply (SNS) without SMN analysis, use the RB209 Index tables based on soil type, previous cropping and winter rainfall, but adjust this if there has been a history of previous manure applications, or the previous crop had an abnormal N rate applied or yield.**
- **Remember that for each field in an NVZ that has been designated from 2002, the Nitrogen Planning rule includes a requirement that the SNS and the planned N application rate Is assessed *before any nitrogen is applied.* Records must be kept including the method used to assess the soil N supply.**
- **Main N applications should take account of the farms Break Even Ratio (BER). Provided N use has been about right in previous years, reduce N rates in 2009 by 8-10 kg/ha for each unit change in BER. The grain N/protein content of previous crops is the best way of assessing if previous year's N use has been right.**
- **Allow for the crop available N supplied by organic manures that have or will be applied. Each application can supply significant quantities of NPK depending on what, how much, when and how the manure is applied, worth up to £500 per application.**
- **If you are using urea, be aware that there can be large losses of N as ammonia and the spreading characteristics of urea are different to those of ammonium nitrate. Try and apply urea just before significant rain, and to feed rather than milling wheat crops (as urea can result in lower grain protein contents). Calibrate fertiliser spreaders for urea.**
- **For land in an NVZ, remember to comply with all relevant rules, implemented in January 2009. Further 'Question and Answer' advice on the NVZ rules, issued by Defra and the EA, can be found at http://www.environment-agency.gov.uk/business/sectors/54714.aspx.**

Over-winter rainfall and soil mineral N (SMN) residues

The rainfall map below shows the Excess Winter Rainfall (EWR) this winter up to 09.00 on Wednesday 18 March 2009 – this is the amount of water that drains from the soil causing loss of nitrate due to leaching. This can be compared with the Long Term Average for the whole winter period to the end of March. Although there may be some further drainage and nitrate leaching if there is heavy rain in late March/early April, these values of excess rainfall are not likely to increase significantly.

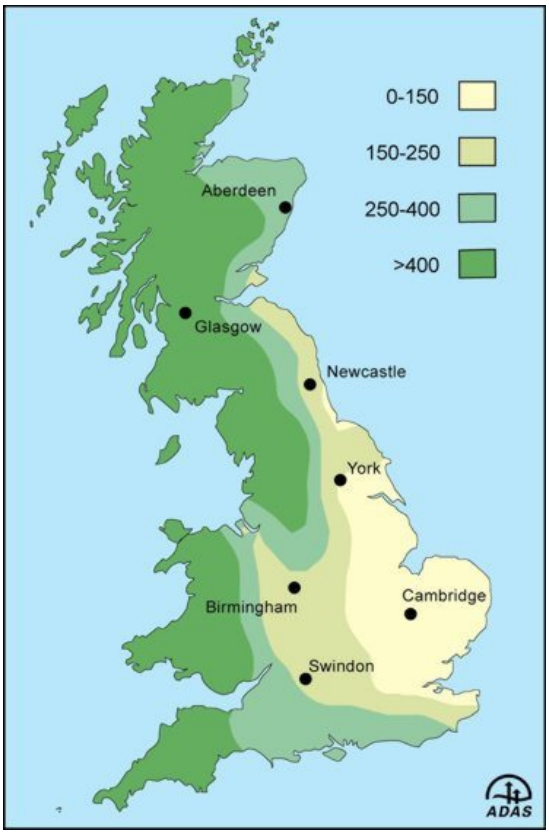
It can be seen that that rainfall this winter has generally been higher than the long term average. This means that the leaching of soil N residues that were left in the soil last autumn is likely to have been higher than normal. Where more than 150 mm excess rainfall has fallen, assessments of the soil N supply (SNS) using the RB209 Field Assessment Method should use Table B for 'Moderate rainfall'. More of East Anglia and the Midlands has received over 150 mm of excess rainfall this year than in an average year. However, large areas of Eastern England have received less than 150 mm of excess rainfall, and in these areas the RB209 Table A for 'Low rainfall' should be used. As normal, most of the South-West, West Midlands and North England have had more than 250 mm of excess rainfall, and in these areas, Table C for 'High rainfall' should be used.

Where the soil N supply in individual fields is assessed using the Field Assessment Method based on soil type, previous cropping and rainfall, the following additional factors should also be considered and may influence the SNS Index assessment. Where soil samples have been taken to assess the soil N supply, then the results of these analysis are the best estimate of the SNS …but make sure you allow for crop N at the time of sampling, and release of N due to mineralisation during the spring and summer.

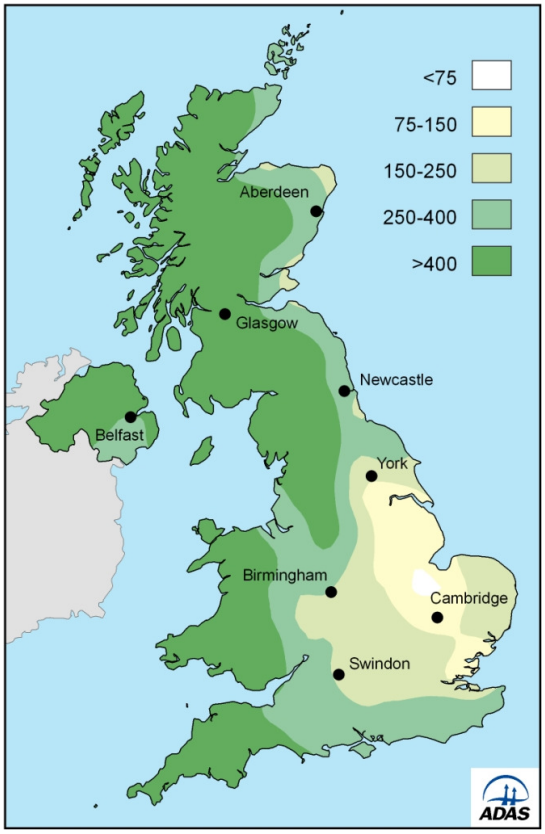
- Where regular applications of organic manures have been made to previous crops in the rotation, increase the SNS Index value by one or two levels depending on the manure type, application rate and frequency of application.
- The SNS Index values assume that the previous crop grew normally and that it received the recommended N rate. The Index may be higher if the previous crop was low yielding or over-fertilised, or may be lower where the previous crop was high yielding with a high offtake of N.
- The SNS Index may be higher in rotations that are predominantly of leafy vegetables, since mineralisable soil N can persist for several years especially in drier parts of the country. The SNS Index is likely to be particularly high for a second vegetable crop grown in the same season (e.g. brassicas).

Note 1: *Remember, that for each field in an NVZ that has been designated from 2002, the Nitrogen Planning rule requires that the SNS and the planned N application rate Is assessed before any nitrogen is applied. Records must be kept including the method used to assess the soil N supply.*

Note 2: *Where any nitrogen has been applied this spring (as bag fertiliser or organic manure) it is now too late to take soil samples for soil mineral N analysis.*



Excess winter rainfall
(long term average at 31 March)



Excess winter rainfall
(at 18 March 2009)

Break Even Ratios (BER) and reacting to high fertiliser prices

Fertiliser prices continue to be volatile, and many farmers with fertiliser already on the farm may be frustrated by the recent significant drop in prices. However, the reality is that decisions on N use this spring should take account of the actual price paid for nitrogen whether this was at the peak of the market or not. Decisions should also take account of a best estimate of the likely price for the crop after harvest – although no-one can predict this with any certainty, an estimate of the likely range of possible prices is feasible.

Using this information, every farmer should calculate the Break Even Ratio (BER) applicable on the farm. Calculating the likely maximum and minimum BER may be appropriate if you expect the market price for the crop to be within a range, say between £110-130 per tonne. The box shows how to calculate the BER. Figure 1 illustrates the effect of reducing the N rate on yield and grain protein content. The N recommendations for cereals in the current RB209 (published 2000) are based on a BER of 3:1. The BER for N decisions to cereals in 2009 is not likely to be less than 6:1 or 7:1, and may be as high as 10:1.

Calculating the Break Even Ratio (BER)

The breakeven ratio is the kg grain needed to pay for 1 kg of N. It is calculated as follows.

$$\frac{\text{Price (£) per tonne of fertiliser} \times 100}{\text{Percent N in the fertiliser} \times 10} = \text{pence/kg of N}$$

$$\frac{\text{Price (£) per tonne of grain/seed}}{10} = \text{pence/kg of grain or seed}$$

$$\text{Breakeven ratio} = \frac{\text{pence/kg of N}}{\text{pence/kg of grain or seed}}$$

Examples.

If AN was purchased at £345/t, and grain is expected to fetch £100/t, then the BER is 10:1

If AN was purchased at £290/t, and grain is expected to fetch £120/t, then the BER is 7:1

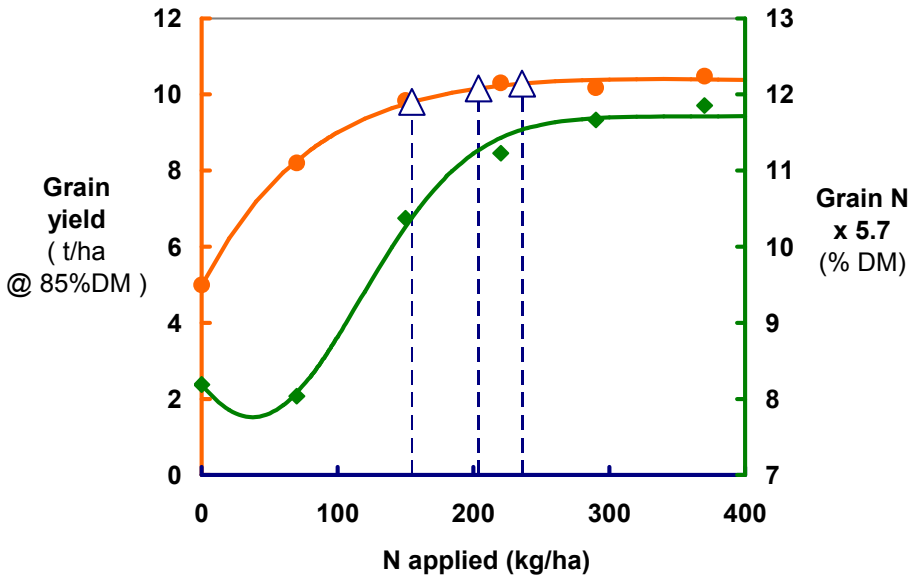


Figure 1. Typical effect of increasing N rates on grain yield and protein content - the vertical lines (from left to right) are economic optimum N rates for BERs of 10, 5 and 3.

Points to note are:-

- As the cost of fertiliser N increases relative to the price obtained for the crop, so the economic optimum rate of N to apply to the crop reduces. This is because it takes more kg of crop produce (e.g. grain) to pay for 1 kg of N.
- Because the economic optimum N rate is on the flat part of the nitrogen/yield response curve, reducing the N rate as BER increases only results in a small loss of yield. As a rule of thumb, reducing the N rate by 50 kg/ha (e.g. from 200 to 150 kg/ha) will only reduce grain yield by about 0.3 t/ha, which in practice will not be visually noticeable.
- On many farms, the BER for N decisions in 2009 will be higher than in previous years. This will mean a reduction in the economic optimum N rate for 2009 compared to previous years, *provided that N decisions in previous years have been correct and close to the optimum N rate for the crop.* Before making any reduction from N rates used in previous years, previous crop information should be assessed to judge if the farm strategy for N use in previous years has been too high, about right, or too low. Information on the grain N/protein content of previous crops is the best guide. If N use has been about right, then the grain N for feed wheat will be around 2.0% (11.4% protein), and for milling wheat around 2.2% (12.5% protein, without extra N applied to boost protein). Lush or lodged crops may indicate that N use has been too high. Some farms may have been using insufficient N in previous years to wheat crops where standard recommended N rates have been used for high yielding crops. Recent evidence has shown that modern high yielding wheat varieties justify higher rates of N.
- If you are confident that N rates have been about right in previous years, then reduce these N rates by 8-10 kg N/ha for each unit change in BER. For example, if the farm BER was 4:1 last year but is 8:1 in 2009, then the appropriate reduction would be 30-40 kg N/ha. If past N use has been too low (e.g. due to high yield levels) then any reduction may be less or not justified. If past N use has been too high (e.g. high grain N/protein or lodging occurred), then larger reductions in N use may be justified.

Milling wheat crops

Reducing the N rate will have a more significant downward effect on grain protein content which is very important for milling wheat producers. This means that once the decision has been made to grow milling wheat, farmers should apply a rate of N that, using experience, is needed to meet the protein target (usually 13%). This will usually mean no reduction in the N rate because of a higher BER. It will mean a higher cost for growing milling wheat compared to feed wheat. This means that there should be a high level of confidence of achieving all of the quality requirements, including protein content, before attempting to grow milling wheat.

Make use of the huge value of manure nutrients *(up to £500/ha per application)*

The fertiliser value of organic manures has always been worth a lot of money, but this value has increased enormously in the last year or two as NPK fertiliser prices have increased. One typical manure application can be worth *up to £500 per ha* in terms of its potential NPK value (see table below) – and there may be additional benefits from improving soil organic matter levels and workability. Farmers who have their own organic manures now have a very valuable product to utilise. Farmers who are able to source organic manures from neighbours can also potentially make large financial savings by reducing the need for purchased fertilisers. It may be worth spending time looking around for useful manures to replace bag fertilisers.

Typical values for the NPK ‘fertiliser replacement’ value of some common organic manures are shown in the table below.

	Crop available Nitrogen kg/ha (£/ha)	Total Phosphate kg/ha (£/ha)	Total Potash kg/ha (£/ha)	Total financial value of one application (£/ha)
Pig slurry (30 m^3/ha)	60 (£60)	60 (£81)	75 (£71)	£212
Poultry litter (8 t/ha)	70 (£70)	200 (£270)	144 (£137)	£477
Cattle FYM (40 t/ha)	40 (£40)	140 (£189)	320 (£304)	£533
Digested sewage sludge (80 m^3/ha)	80 (£80)	120 (£162)	0 (£0)	£242
Green compost (30 t/ha)	Low	90 (£122)	195 £185)	£307

Financial values based on AN @ £345/t (100p/kg N); Triple Superphosphate @ £635/t (135 p/kg P_2O_5); Muriate of Potash @ £570/t 95 p/kg K_2O)

When deciding on the application and NPK value of individual manure applications:

- Make sure you apply manures to fields that have a need for all or most of the nutrients that are in the manure – you will waste the NPK value if the field or crop has no requirement for nutrients.
- Apply manures as accurately as possible. Depending on the equipment used, an overlap spread pattern may be needed.
- On fields inside an NVZ, comply with the new NVZ rules.
- Consider sending manure samples for laboratory analysis. This will provide a specific NPK content for the manure. Include analysis for ammonium-N (and uric-acid N for poultry manures) which measure the readily available N content (this is equivalent to fertiliser N).
- Usually regard the <u>total</u> P and K content of the manure as equivalent to fertiliser PK (unless the soil is at Index 0 or 1, or a responsive crop is being grown).
- Allow for losses of readily available nitrogen by leaching (least from spring applications) and ammonia volatilisation (least from manures incorporated into the soil). Use either RB209, or the MANNER or PLANET software programmes to calculate how much manure N will be available for crop uptake. Ring 08456 023864 for a free copy of PLANET or MANNER.

Using granular urea

Nitrogen as urea (46% N) has been significantly cheaper per kg of N than ammonium nitrate (34.5% N) or liquid N in recent months which has attracted many farmers to switch to urea this season. If the price per tonne of urea is the same as per tonne of ammonium nitrate, then the cost of the N as urea is 25% cheaper than the cost of the N as ammonium nitrate.

However cheaper does not necessarily mean better, and there are some significant potential problems when using urea that farmers should be aware of and, where possible, take steps to minimise or avoid.

- Recent Defra-funded research (replicated small plots at many sites) has shown that <u>on average</u>, 22% of urea-N applied to arable crops was lost as ammonia gas, and 27% when applied to grassland, compared to 2% from use of AN. There was a wide variation in the amount of urea-N lost (2 to 58%). This variation was partly but not fully explained by weather and other conditions. Significant rainfall (more than a shower) immediately following application helped to reduce losses. Soil type did not have any major influence on the magnitude of the N loss. Losses are likely to be largest when the soil is dry, the weather is warm and crop canopies are small and open.

  <u>Action:-</u> *To minimise ammonia losses, try to apply urea immediately before significant rain. Use urea for early season applications but do not assume that this will prevent losses of ammonia.*

- Using urea in place of AN may give a small loss of yield (often not visually noticeable), but will give a more significant reduction in grain protein content.

Action:- *Use urea on feed rather than milling wheat crops where grain protein content is important.*

- Urea is less dense than ammonium nitrate so there can be a greater risk of uneven spreading than when ammonium nitrate is used. The risk is much greater for prilled urea than granular urea which has a larger granule size. Research has shown that granular urea can be spread on 24 metre tramlines with a good accuracy provided the spreader has been calibrated properly. It may not be possible to spread prilled urea across more than 12m bout widths except with a pneumatic spreader. Urea spreading may be more susceptible to strong winds.

  Action:- *Calibrate spreaders with urea. Avoid attempting to spread to more than 24 metres (granular) or 12 metres (prills).*

The new NVZ rules – implemented on 1st January 2009

All farmers should be aware by now if they have land designated in an NVZ. There is now 68% of England designated as an NVZ, 14% of Scotland and 4% of Wales. All land designated in an NVZ in 2002 or before, must comply with the new rules from 1st January 2009. All newly designated land must comply with the new rules from 1st January 2010. Some rules have a longer transition period for compliance.

Full details of the rules are given in the Guidance for Farmers in NVZs leaflets available from Defra, the Welsh Assembly and the Scottish Government. Further advice is available by ringing the NVZ Helpline on 0845 345 1302**.**

Further 'Question and Answer' advice on the NVZ rules, issued by Defra and the EA, can be found at http://www.environment-agency.gov.uk/business/sectors/54714.aspx.

The PLANET v2.0 software was released in November 2008. In addition to generating field-level RB209 recommendations (N, P, K, S, Mg, Na and lime) and allowing a field-specific nutrient application plan to be devised, PLANET v2.0 is recognised by Defra and the Environment Agency (EA) for carrying out calculations and producing reports which help assess and show compliance with the revised NVZ rules. In addition to general improvements to make it easier to use, the new version contains the following new modules. A ***free*** copy of PLANET can be obtained by visiting www.planet4farmers.co.uk or by ringing the PLANET Helpline on 08456 023864.

20 March 2009

(This technical note has been written by ADAS on behalf of Defra)