

Coping with the fertiliser challenge

AN AGRONOMIC GUIDE TO IMPROVING NUTRIENT USE EFFICIENCY

THE FERTILISER CHALLENGE:

An introduction by Chris Tye

- + Nitrogen is one of the key drivers of crop production and is an essential element in terms of yield development and quality in many crops.
- + Recent events have led to unprecedented price rises in the UK fertiliser market. This has come about mainly due to the rapid increase in European gas price, which has been widely reported in the press and has been caused by a number of factors including; tight supply, increased demand due to limited supply, low storage capacity etc.
- + Natural gas is the key raw material for the production of nitrogen fertilisers (via the Haber Bosch process). This turns the natural gas in conjunction with the nitrogen from the atmosphere into ammonia, which in turn is then converted in fertiliser plants to finished products such as granular urea, ammonium nitrate or liquid fertiliser (UAN).
- + A by-product of this process is CO_2 , and because of the high gas price many fertiliser manufacturers across Europe took the decision to reduce or even stop production as it became uneconomical at the prevailing fertiliser price level. The consequence of this in the UK was felt when CF stopped production at its two plants on Teesside & Cheshire leading to CO_2 production coming to a halt, and subsequent UK supply chain issues.
- + In addition to the rapid rise in gas price, fertiliser markets have been further pushed to near record levels by several other factors including freight rates and reduced exports from countries such as China.
- + The effect of all this that we are now faced with nitrogen prices that are more than double the price at the beginning of the season and nearly three times more than the start of last season.
- + Nutrient use efficiency (NUE) is the proportion of the applied that is taken up by the crop and for nitrogen this is often quoted as being only between 50 and 60%. We need to reduce the amount that is not used by the crop as this can lead to potential losses to the environment (leaching, nitrification, volatilisation etc). So NUE is more important now than ever from both an environmental and an economic point of view.
- + In order to improve Nitrogen Use Efficiency it is essential that crops are in a suitable state to respond to bagged fertiliser applications, so making sure soils are in good structure and root systems are not compromised. Nitrogen can be measured in soils using the N-Min or SMN system and its crucial that levels are understood and captured nitrogen in terms of GAI has been measured. Once crop captured N is accounted for we can tailor nitrogen applications subject to the season and the influence of weather during the growing season. It is also important not to neglect the importance of other nutrients involved with NUE such as sulphur and potassium. All cereal crops should receive sulphur in the form of sulphate to ensure effective uptake of N, and chlorophyll and protein production.

What we need to consider is how can we optimise the use of this key input to maintain yield ...

THE PURPOSE OF THIS DOCUMENT

This document brings together knowledge from various quarters, some of which is out in the market place or has been produced by AHDB, but much is based on Agrii R&D insights.

Its purpose, is to provide some ideas for discussion with your agronomist on how to make the most of 2022 crops either planted or intended to be planted, with potential constraints on fertiliser rates, cost and access.

Not all of the information is immediately relevant but is included here nevertheless for completeness – we may end up in a similar position in 2022/23....

Layout: The following pages include key take-home points, with more detail in the tables that follow. Each action is colour-coded to give you an indication of where the greatest chance of a benefit lies.

We hope you find this useful.

The Agrii Technical Team



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KEY TAKE HOME POINTS

SOIL STRUCTURE: HOW TO IMPROVE IT

- + Organic matter: apply organic manures if possible but watch new Farming Rules for Water (FRfW)
- + Cover crops – consider in the future for OM improvements, ability to fix Nitrogen and rooting improvements in subsequent crops
- + Drainage – attend to for maximum root development
- + Liming – optimum pH is critical for nutrient access



CROP ROTATION/SEED RATES:

- + Differential fertiliser requirements for crops – consider change to rotation
- + Loss of tillers a risk if sub-optimal nitrogen – consider upping seed rates if N limited



FEED TO NEED: VARIABLE RATE APPLICATION

- + Spring crops – consider RHIZA soil sampling to ensure that adequate levels of P&K are applied to not limit yield from a baseline nutrition. Also don't forget pH: spring barley is particularly sensitive and therefore incorrect pH will knock the crop harder, and with lower N applied the crop may not recover as well.
- + Winter crops – although already drilled it is not too late to ensure that base nutrition levels are adequate. Soil Mineral Nitrogen sampling helps understand the soil nitrogen supply index, using this and satellite imagery we can target nitrogen inputs to best apportion the spend. This could be a year to be ruthless with crops. Any areas of fields that are marginal should receive some nitrogen but areas where there is the potential for higher yield should receive the 'lion's share'. Feeding the yield potential will be crucial this year in order to get the most from your investment. All RHIZA customers will have access to satellite imagery FOC, for those not on a Variable Rate / Precision digital subscription it is simple and easy to upgrade; contact your agronomist, RHIZA account manager or email info@rhizadigital.co.uk.



FERTILISER CHOICE - NUTRIENT USE EFFICIENCY (NUE)

- + AgriiStart fertilisers – have shown improved NUE e.g. Release, Liquisafe, Enhance
- + Consider foliar N – integrate alongside bagged N if appropriate, eg Intrafol N28
- + Ensure K balanced with N – synergistic effect allows maximum effect from applied N eg Polysulphate
- + Incorporate S - to improve Nitrogen Use Efficiency. Alternatives to DoubleTop exist, e.g. Onset Standards.



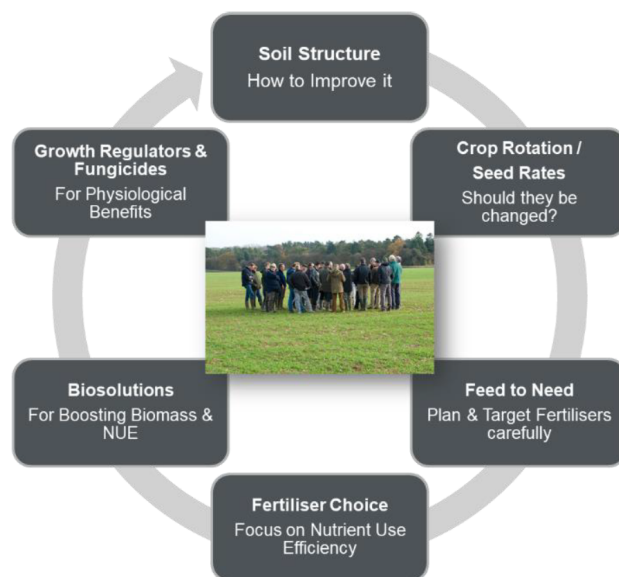
BIOSOLUTIONS - FOR BOOSTING BIOMASS AND NUE

- + Take-Off seed treatments for spring OSR – establishment tool which helps early N metabolism
- + Zax / i-Man seed treatment for spring cereals – both zinc and manganese aid N utilisation
- + NutriPhite PGA / Quark / Physiocrop all boost rooting & biomass
- + Ensure other micronutrients are balanced according to need (for NUE especially manganese, zinc, molybdenum & copper) with a particular focus on humic acids for maximum biostimulant effect (stress relief) and maximum nutrient uptake eg Zinic, HuMan xtra
- + Use Agrii / Lancrop tissue testing service in-season to accurately determine need



GROWTH REGULATORS & FUNGICIDES: FOR PHYSIOLOGICAL BENEFITS

- + Some strobilurin and SDHI fungicides – improved greening is well documented eg Pyraclostrobin
- + Early season PGR use in cereals – proven rooting improvements eg Adjust, Alatrino Evo



Soil Structure & How to Improve it		
<p>✓ INCORPORATE ORGANIC MATTER AT AN APPROPRIATE TIME IN THE ROTATION</p> <p>Where legal! Note new Farming Rules for Water.</p>	<p>Raising soil organic matter using sewage sludge or FYM, significantly improves the soil's capacity to store and supply essential nutrients and carbon, enhances the water holding capacity and workability, and enables soils to better cope with acidity.</p> <p>However, the new limitations on use organic manures in England (FRfW) makes this more difficult, with restrictions around Autumn applications unless a need can be demonstrated. This effectively rules out applications in the autumn & winter to crops other than Grassland and Winter Oilseed Rape.</p>	VERY HIGH
<p>✓ PLANT COVER CROPS</p> <p>To improve fissure depth & rooting capability</p>	<p>Appropriate choice of Cover Crops will both reduce Nitrate leaching, trapping the Nitrogen to enable it to be available for use by Spring crops, and also improve fissure depth and number so soils are more workable and root development facilitated. Pulse options will also help to fix Nitrogen. In the longer term the roots and biomass returned to the soil will lift organic matter and boost carbon sequestration.</p> <p>Your agronomist or seed department will be able to advise on the best mixes for root development. Seed really needed to be drilled by end August.</p>	HIGH
<p>✓ ENSURE GOOD DRAINAGE</p> <p>Minimise compaction and drainage issues</p>	<p>Optimise soil structure through correct cultivations and drainage measures. This will ensure rooting at depth is adequate and nutrients fully available. Waterlogged crops are poor rooters and nutrients less available.</p>	HIGH
<p>✓ LIME FOR OPTIMUM pH</p> <p>Ensure nutrients more available</p>	<p>Calcium is important as it helps with flocculation and crumb structure. Also, pH has a massive effect on nutrient availability and rooting depth, so take the opportunity to correct ahead of spring cropping.</p>	HIGH
Should Rotations / Seed Rate Change?		
<p>✓ COMPARE CROP REQUIREMENT FOR FERTILISER</p>	<p>At this point there may be limited scope for any change – and hopefully those conversations will have been had already. Obviously, Winter versus Spring crops have different fertiliser requirements.</p>	HIGH
<p>✓ SHOULD SEED RATES INCREASE?</p>	<p>Higher seed rates may want to be considered if wheat not yet drilled. Any fields where Nitrogen levels may have to be sub-optimal due to inability to access may require higher seed rates to take account of possible tiller loss. Various seed treatments may improve establishment – see later.</p>	HIGH
Feed to Need – Plan & Target Fertilisers Carefully		
<p>✓ LOOK AT BREAK EVEN RATIO (BER)</p> <p>This allows you to assess how much to reduce N rates based on the price you paid in relation to crop value</p>	<p>BER is a calculation of the economic optimum of fertiliser N based on the crop yield in kg needed to pay for 1kg of Nitrogen. The calculation is shown below. Agrii have updated updating the RB209 table on page 34 (in Section 4 of RB209) as ammonium nitrate value only goes up to £483 / tonne! This is available from your Agrii agronomist. On average, a change in BER by 1 point should indicate a reduction in Nitrogen of 10 kg. However, adjustments based on BER are unlikely to be appropriate where growing a milling wheat with a target protein of 13%.</p> $\text{BER} = \frac{\text{Cost of nitrogen in pence / kg}}{\text{Value of crop produce in pence / kg.}}$	VERY HIGH
<p>✓ UTILISE PRECISION TOOLS</p> <p>To ensure fertiliser is targeted where most needed. Variable seed rate may be useful if tiller loss is a risk due to lack of N.</p>	<p>Spring crops – Look at RHIZA soil sampling to ensure that adequate levels of P&K are applied so as not to limit yield from a base nutrition perspective. Don't forget pH as spring barley will have a higher sensitivity and therefore will knock the crop harder - with lower N applied may not recover as well.</p> <p>Winter crops – although already drilled it is not too late to ensure that base nutrition levels are adequate. With the integration of SMN sampling to understand soil supply we can target Nitrogen inputs using satellite imagery to best apportion the spend. Areas of fields that are marginal should receive Nitrogen but areas where there is the potential for yield should have the 'Lions share'. Feeding the yield potential will be crucial this year to get the most from your investment. All customers will have access to Satellite imagery FOC so you can easily upgrade to a VR package.</p>	VERY HIGH

✓ TEST SOILS (N-MIN) & USE GAI + Agrii N CALCULATORS SMN & AAN give a good indication of available N. Use with GAI in Agrii N calculator	Use Soil N-Min testing to guide crop need for nitrogen (Soil Mineral Nitrogen SMN and Additionally Available Nitrogen AAN plus active Carbon). This will help understanding of how “available” mineralised N might be. A recent study of 75 tramline trials confirmed how N-Min testing improved Nitrogen Use Efficiency. Information may then be used together with Green Area Index (GAI) in Agrii Crop Nitrogen calculators to refine does rates required. These are available from your Agrii agronomist.	VERY HIGH
✓ EXAMINE HISTORICAL GRAIN PROTEIN DATA Looking back at grain protein data to indicate possible N savings on a field x field basis	RB209 states: For those farms monitoring grain protein content, the economic optimum is about 11% (1.9% N) for feed wheat and 12% (2.1% for bread-making wheat. If levels have been higher than this consistently over a number of years from a number of adjacent fields then nitrogen fertiliser rates may be adjusted down or up by 25kg N/ha per 0.5% difference in grain protein (30 kg N/ha per 0.1% difference in grain %N).	MODERATE
Fertiliser Choice – Improving Nutrient Use Efficiency		
✓ AGRIISTART FERTILISER RANGE AgriiStart fertilisers deliver proven improvements to Nutrient Use Efficiency	With Nitrogen at the cost it is it is more important than ever to select products formulated to deliver Nitrogen most efficiently, for example: <ul style="list-style-type: none"> • Use of AgriiStart Liquisafe to improve Nitrogen Use efficiency by 15% through reducing losses and preventing leaching; • Use of AgriiStart Release to prevent P lock-up and make other nutrients more available; • Use of AgriiStart Enhance granular urea to ensure N is protected and stabilised, reducing volatilisation, leaching and nitrification 	VERY HIGH
✓ CONSIDER INTEGRATING FOLIAR NITROGEN Alongside solid products – but depends on pricing	These products historically have not stacked up well economically against solid Nitrogen. However, with the huge price hikes in N this needs to be kept under review, although the original N source used to make them will also have increased in price. Consider products such as Intrafol N28 (28% N made from urea and polymethylene) to bolster reduced rates of nitrogen – they also have been used historically to lift protein levels.	MODERATE
✓ ENSURE K IS BALANCED ALONGSIDE N Resist taking a K holiday - Potash plays a vital role in Nitrogen metabolism	Potassium improves Nitrogen Use Efficiency through enabling better N uptake and utilisation. The International Potash Institute has reviewed multiple experiments and have concluded that across a variety of crop types and climate, a typical K application of between 30 – 150 K ₂ O results in improved Nitrogen Use Efficiency of 10 - 40%. K may be applied as fertiliser if it can be sourced at an appropriate cost or it could be applied as Polysulphate .	HIGH
✓ INCORPORATE SULPHUR INTO PROGRAMMES Sulphur improves Nitrogen Use efficiency – 85% of UK soils have been shown to be deficient	Sulphur helps with N utilisation – Nitrogen cannot be taken up and used efficiently unless there is Sulphur present. Both Sulphur and Nitrogen are vital building blocks of protein and work together. It may be worth considering Autumn S IF it can be accessed and sourced at a reasonable cost. If not, there are other options, such as Polysulphate (contains Sulphur, Potash, Magnesium and Calcium) which is soluble, easily absorbed with prolonged release. Alternatively, there is a range of elemental S which may be applied as prills (eg Onset Standard).	VERY HIGH
Biosolutions - Boosting Biomass & NUE		
✓ TAKE OFF SEED TREATMENT Bio-stimulant seed treatment	Obviously too late for winter crops, but worth considering for spring crops. Take Off OSR seed treatment is a root bio-stimulant containing phosphite + Pyroglutamic acid (PGA), which can aid establishment, canopy size and help early nitrogen metabolism. The majority of Agrii oilseed rape seed is treated with it to boost early crop vigour.	VERY HIGH
✓ ZAX (Zn) or iMAN (Mn) SEED TREATMENT	Both Zinc and Manganese are important for Nitrogen metabolism – and rooting. Consider for spring crops where consistent yield benefits have been seen – without any limitation on N use.	HIGH

<p>✓ CONSIDER BIOSTIMULANTS & GROWTH PROMOTERS THAT BOOST ROOTING & CANOPY GROWTH</p> <p>The larger the crop canopy going into the winter, the greater the amount of nitrogen trapped. The greater Green Area index when used in Agrii N calculators may reduce N required.</p>	<p>There are a number of biostimulants that have been proved to aid root development, and boost canopy size coming out of the winter. Maximising / increasing growth pre-spring will help capture N that would otherwise be lost over winter. This enhanced Green Area Index may then be used in an Agrii Crop Calculator which will take into account the larger canopy size and may advise a reduction in Nitrogen.</p> <p>Examples of products include Nutri-Phite PGA (a stable phosphite + pyroglutamic acid) or Quark (ammoniacal nitrogen, zinc and manganese), both of which contain elements which boost root development and also improve crop metabolism.</p> <p>More roots tend to lead to greater canopy growth due to the improved nutrient scavenging capability. Quark also contains zinc which has also been shown to help Nitrogen metabolism – best used in the earliest part of the season.</p> <p>Various amino acids such as Physiocrop also improve metabolism and canopy.</p>	<p>VERY HIGH</p>
<p>✓ ENSURE THAT OTHER FOLIAR NUTRIENTS ARE BALANCED & TARGETED TO MAXIMISE NITROGEN UTILISATION</p> <p>Many micro-nutrients play an important role in supporting Nitrogen utilization in the plant. Use humic acid-based products for maximum effect.</p> <p>Use Lancrop / Agrii in-season tissue-testing service to tailor nutrient x crop x growth stage at sampling.</p>	<p>In addition to Sulphur and liquid Nitrogen mentioned above, foliar nutrition also plays a part in ensuring there is enough Nitrogen available to the plant and that it is utilised well.</p> <p>Humic / fulvic acid biostimulant based products (eg MoBo, HuMan Xtra, Mensa, Zinic) offer synergies with other CP products like PGRs and fungicides and offer enhanced nutrient uptake and associated stress relief.</p> <p>The Agrii / Lancrop tissue-testing service facilitates recommendations based on crop need according to growth stage at the time of sampling.</p> <ul style="list-style-type: none"> • Molybdenum is important as it improves how Nitrogen is utilised in the plant – it is essential for the production of nitrate reductase • Nitrate formulations of micronutrients are particularly valuable and rapidly taken up by plants • Watch Zinc levels – Zinc deficiencies have been shown to reduce nitrogen metabolism by up to 50%. • Manganese and Copper too have been shown to be important in nitrogen metabolism. 	<p>VERY HIGH</p>
<p>Growth Regulators & Fungicides – For Physiological Benefits</p>		
<p>✓ ROOT PROMOTION BY PLANT GROWTH REGULATORS & FUNGICIDES</p> <p>Many PGRs have positive effects on root development.</p>	<p>Maximising root development is key to enabling crops to mine the soil for Nitrogen and other nutrients.</p> <p>Certain PGR-acting fungicides used in oilseed rape, such as Architect, have proven effects on root development as demonstrated by glasshouse tests at Nottingham University. This has also been supported by field trials at ADAS Rosemaund that showed improvements to rooting at depth.</p> <p>In Cereals, PGRs applied particularly in the early spring have been demonstrated to improve rooting when applied at mid – late tillering. Products need to be selected bearing in mind that chlormequat does not work well at temperatures below 8 degrees – so formulations need to have the ability to work in cold temperatures (eg Alatrin Evo and Adjust).</p>	<p>MODERATE</p>
<p>✓ FUNGICIDES WITH PHYSIOLOGICAL BENEFITS</p> <p>Some fungicides have physiological benefits due to improved N utilisation</p>	<p>This applies largely to strobilurins like pyraclostrobin, and some SDHIs like bixafen. Both have been shown to improve Green Leaf Area and protein levels, suggesting uplifts in either photosynthetic efficiency and / or Nitrogen metabolism. Both actives are available in various forms on the UK market (eg pyraclostrobin is in Tucana, Rylox; and bixafen is in Boogie Plus and Propel)</p> <p>Sulphur-based fungicides such as Vertipin or Thiopron have a dual benefit of providing some Sulphur (see above) but also acting as a fungicide.</p>	<p>MODERATE</p>

It is important to discuss all of the above options with your Agrii Agronomist, in order to determine which, if any, are the most appropriate for your farm at this difficult time

This document is not a guarantee of a successful crop outcome but shares with you, our customers, the best knowledge available from Agrii on this challenging subject.