my technical brief

frontier

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News and crop production advice from Frontier

In this issue

Protecting your investment; cereal disease control

With volatility of cereal output prices set to remain, it is imperative to protect your investment says Stuart Hill, technical and development manager. Driving yield will deliver a relative reduction in the cost of production, as inputs should now be considered a fixed, rather than variable, expenditure.

The spread of varieties is dominated by those which yield well, and disease resistance tends to suffer in parallel with this. This season yield potential is high and cutting costs in disease control where pressure remains is not an option; septoria is ever more difficult to control due to shifts in sensitivity, and yellow rust is becoming increasingly aggressive.

We are already seeing high levels of septoria, and the aggressive Warrior yellow rust race is present on susceptible varieties. More than half the varieties on the HGCA Recommended List have a resistance score of 7 or under, so protection with multi-active mixes will be the main focus for key GS32 (T1) and GS39 (T2) applications of fungicides to winter wheat this season.

The return on investment was clearly demonstrated at our main 3D Thinking sites last year *(Graph 1, see page 2)*. As the main driver for varietal choice evolves over the next few years, more septoria resistant options, such as Relay and Evolution, will play a greater part in rotations. However, it should be noted that the data clearly shows the benefit in response over input cost for all varieties. As chemistry efficacy begins to weaken, robust programmes will still be needed even on more resistant varieties.

Levels of septoria were high across the country this winter and it is clear that we have to take preventative action, as triazoles in particular have lost their curative ability. Five years ago only 50% of the wheat area received a T0 leaf 4 application; last year that number was over 85%. To maintain a fully protective position, this needs to rise to 100%.

As shown in *Graph 2 (see page 2)*, data from our 3D Thinking sites in 2014 indicates that the more disease susceptible varieties show the greatest responses to T0 applications; however, irrespective of variety, T0 is the foundation of disease protection and begins the management of septoria and yellow rust up to the T1 timing. We should endeavour to ensure all crops receive a T0.

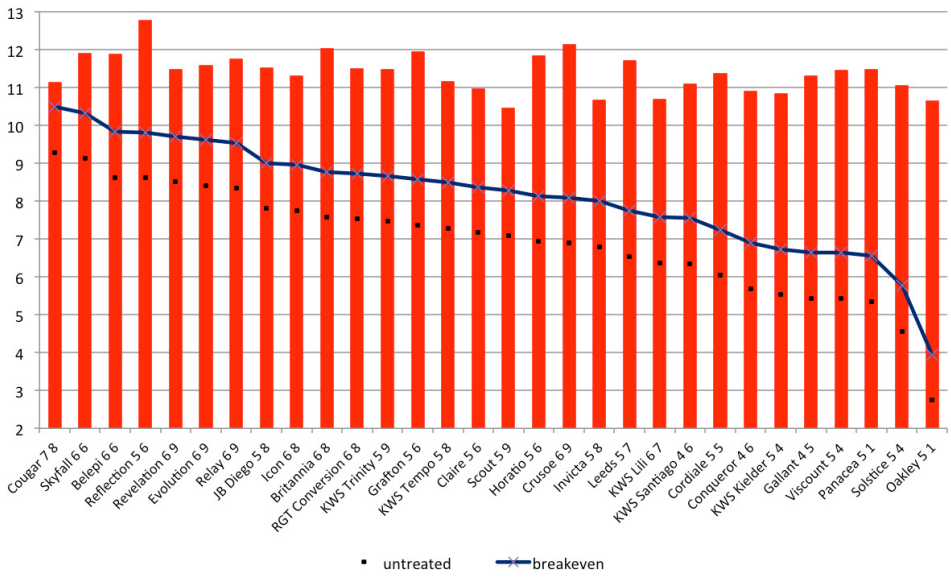
Timing and chemistry choice are the next important decisions. Irrespective of the situation, protectant chemistry, such as chlorothalonil and folpet, should be the first active ingredients in the tank where septoria is the concern. There is then some debate whether a triazole such as epoxiconazole is necessary. Our belief is that if we are to maintain a protective position, a triazole is still required to give some level of control of latent disease. The key triazoles are more effective as protectant than curative products, so it is a great leap of faith to be dropping triazoles from this early stage. The triazole will also be needed if yellow rust is apparent on susceptible varieties.

Yellow rust development has been different this year compared to 2014. Over winter last season, high levels needed prompt treatment well before the T0 timing. This season many varieties became infected in trials over winter, but with the colder spells at the turn of the year, rust levels dampened down and have been more noticeable in the susceptible varieties such as KWS Santiago, KWS Kielder, Solstice, Conqueror, Grafton, Duxford and Claire. However, we cannot relax. The aggressive Warrior race is a significant threat, even to varieties with scores of 8 and 9. It is highly adaptable and 4 variants of the Warrior race have been identified resulting in some changes to varietal susceptibility.

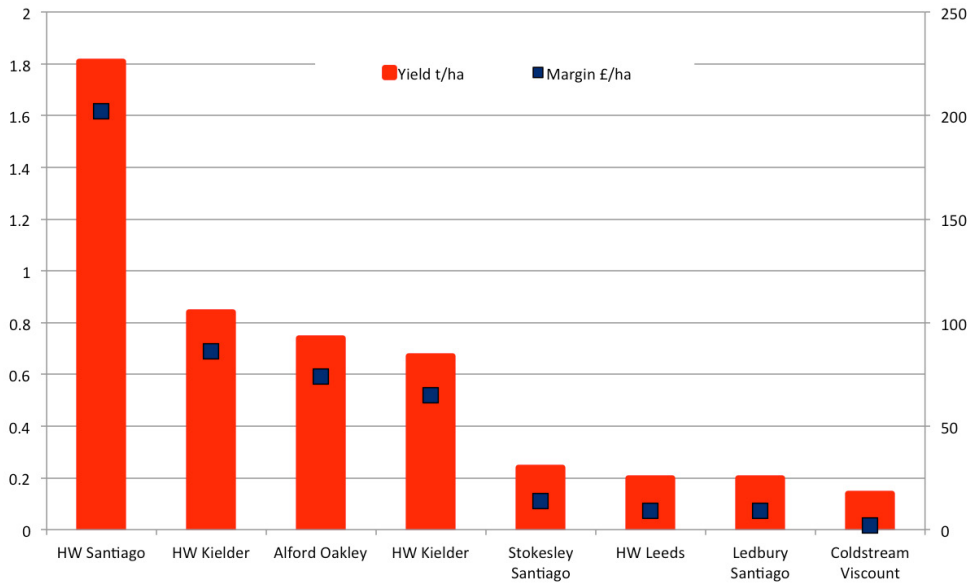
There has been significant debate about the use of SDHI chemistry at T1. The flag leaf is clearly still a priority for yield, but we can no longer afford a situation where disease proliferates rapidly up the plant due to poor chemistry choice or timing at GS32, requiring a reactive eradicant approach at GS39. With septoria pressure already apparent, we must use our best mixture and formulation chemistry for leaf 3 onwards; a view supported by both on farm experience and evidence from our 3D Thinking site at Haywold in Yorkshire. In high pressure situations, using multiple mode of action formulations, including SDHIs at T1 as well as T2, gave a 1.63t/ha increase in yield; a margin over input of £164/ha.

Frontier trials included a 2 SDHI programme versus a triazole/SDHI programme across varieties with different susceptibility to septoria. Even less susceptible varieties demonstrated a benefit from the 2 SDHI programme, as shown in *Graph 3 (see page 2)*. In dry, low pressure seasons there may be room to manoeuvre with rate, but the fundamental inclusion of all the chemistry, SDHI, triazole and protectant, is still necessary, not least for good stewardship. Work carried out by a consortia under an HGCA project modelled the risk of resistance according to practice. The stand out message, as shown in table 1, is that mix partners are critical to help mitigate resistance development.

Graph 1: Variety response to T1 and T2 application SDHI fungicide programme (site: Alford)



Graph 2: Response to T0 fungicide, 2014 (sites: Haywold, Alford, Stokesley, Ledbury, Coldstream)



Graph 3: Response to T1 + T2 SDHI programme over triazole T1/SDHI T2 programme (4 sites, 4 varieties)

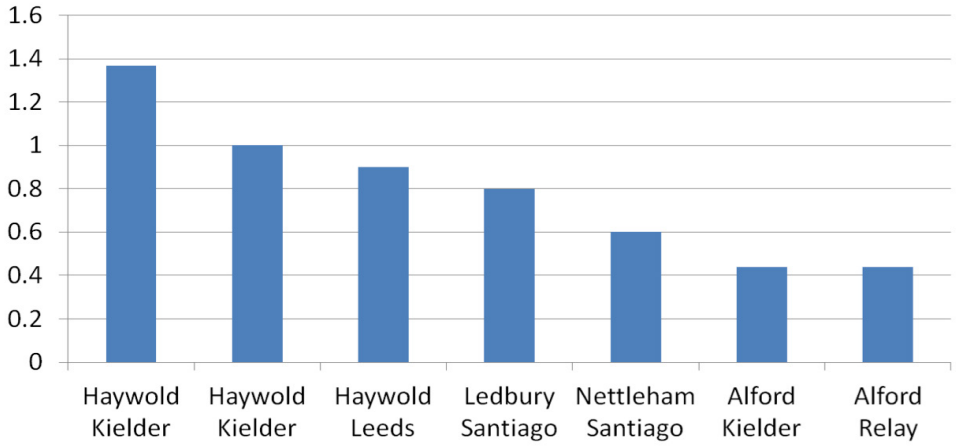


Table 1
Consequences for fungicide resistance

	Increase selection	No effect	Decrease selection
Increase dose	16	1	2
Increase no. of sprays	6	0	0
Split the dose	10	0	1
Add a mixture partner	1	6	46

Van den Bosch *et al.* (2014) *Annual Review Phytopathology*

Accurate timing is also critical. At T1, leaf 3 emerging/emerged (GS32) on the main stem is the time to target. Too early and leaf 3 will be unprotected for 4 or more weeks, too late and septoria infections on leaf 3 will have taken place.

Varieties do differ in their speed of development, for example Skyfall drilled in mid September can reach GS31 up to 10 days earlier than other varieties. Gallant, Crusoe and Reflection are also quicker to develop. If you have a spread of varieties across the farm your agronomist can give guidance on appropriate timing based on the different speeds of development.

As we head into disease management programmes, the keys to success will be:

- Prevention not cure. With existing chemistry the eradicant activity for septoria is limited
- Timing. Assess varieties for speed of development and appropriate application timing (GS32, leaf 3)
- Chemistry choice. Include all core elements available; SDHI, triazole and protectant
- Application. A major challenge is speed. With large areas to cover and wide application widths it is tempting to push to 16kph. Efficacy and drift suffer at this speed. 10 – 12kph is more appropriate.

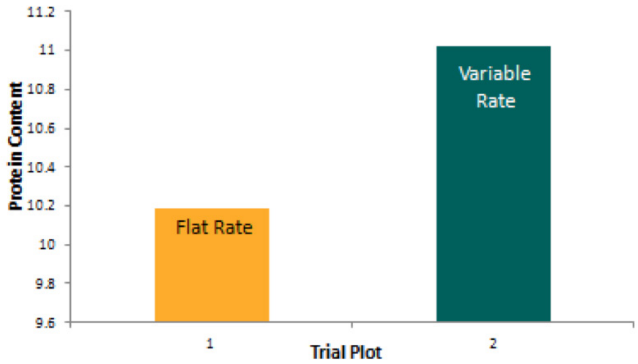
Get all these right and we will be in control of our investment.

Variable rate nitrogen for grain protein management

SOYLsense, SOYL's variable rate nitrogen service, has been successfully running for 10 years. The yield advantages of variably applying nitrogen based on satellite images showing differences in crop growth have consistently been measured between 3-8%. Simon Griffin, technical manager for SOYL, considers an additional benefit of matching N inputs to crop needs in this way; improved protein levels in wheat.

As Edward Downing discusses earlier in this issue, reaching required protein levels in milling wheat has always been difficult, and HGCA figures confirm that many growers do not reach the grain nitrogen levels required to qualify for the milling quality premium.

To optimise the benefits of variable rate N on protein levels, SOYL has developed a recommended method using SOYLsense unique nitrogen models. The first two applications of a three split system on winter wheat follow the normal practice of applying more N to the smaller crop and less to the more forward crops. This evens up canopy development, doesn't push forward areas too hard which can result in overly thick or lodged crops, and ensures that backward crops have sufficient N to increase canopy size and maintain tillers.



However for the third or final application the strategy changes. At this point there is a need to match N inputs to crop nitrogen demand, which is linked to yield. Increased yield, if not matched with increased N rates, will lead to a dilution of protein in grain. There is a direct correlation between greater crop biomass in May, in more fertile areas of the field, and higher final yield. These areas, identified on SOYLsense imagery, are targeted for additional N on the third or final application. At this later stage of the season, a higher proportion of nitrogen applied will be transferred to the crop grain, maintaining the balance between yield and protein content. This method is referred to as the nitrogen reverse model.

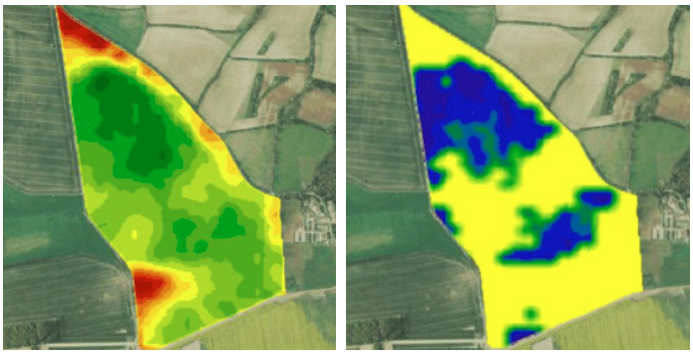
In our 2014 trials, we alternated nitrogen reverse strategies with farmers' best practice at field scale. Within each treatment zone measurements were taken of yield and protein to allow a comparison of the effect of the two strategies.

Grain samples were analysed for N content at harvest from all treatments. There was a clear benefit to using the nitrogen reverse strategy compared to standard farmers' best practice. Over a number of fields the average benefit was an increase of 0.83% N.

Foliar N application

Applying foliar nitrogen to a wheat crop later in the season is a well established method of raising protein levels in the grain. A number of growers have been successfully using SOYLsense satellite imagery to vary application rates of foliar nitrogen. The images identify areas where yields are likely to be higher; in turn this may result in diluted proteins and lower N content than in less fertile areas of the field. As above, these thicker areas are targeted for increased application rates of foliar N as they are likely to be the parts of the field most in need of a grain nitrogen boost.

The advice from the SOYLsense team is to use the nitrogen reverse model for the last application on milling wheats. Matching the N inputs to higher yielding areas will result in higher proteins and increased likelihood of achieving the milling wheat premium. For further advice on this approach, contact the SOYLsense team on 01636 204198.

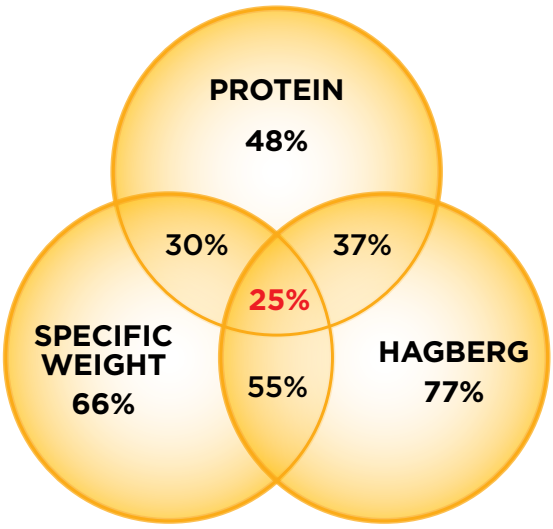


Higher biomass areas in dark green (left) receive higher rates of N shown in blue (right)

Hitting the quality requirements of milling wheat

Producing grain that meets the top specification is not an easy process. Edward Downing, southern fertiliser technical manager, examines the evidence and considers the options for maximising the yield and quality of your milling wheat.

The diagram below shows the percentage of wheat that has achieved the top specification over the last ten years.



Just 25% of group 1 grain has met all three of the specifications to gain the full premium. The most common reason for missing out is failing to meet the 13% protein requirement, with less than half achieving this level. But these averages hide the huge variation that we have seen in that 10 year period. The table below breaks down the results by year, based on HGCA data.

Year	Specific Weight (%)	Hagberg (%)	Protein (%)	Full Specification (%)
2014	76	89	15	9
2013	76	98	52	38
2012	9	45	62	3
2011	91	86	50	40
2010	77	86	46	30
2009	74	72	39	22
2008	68	58	14	6
2007	62	51	38	11
2006	60	98	79	47
2005	71	84	80	48

Two years of particular interest are 2008 and 2014, when increased yields significantly diluted grain protein to the point that only 6% and 9% respectively of grain in those years achieved the full premium. Had we reacted better to the yield potential, applied more nitrogen later in the season and increased the use of foliar nitrogen applications, more grain could have achieved full milling specification.

This contrasts with 2012 when crops looked fantastic in early May, only for the rain to start and the sun to disappear. As a result, yields reduced and therefore protein levels were, in the main, very good. The lesson that we need to learn from this is that we must be better prepared to react to the seasons and manage our crops differently, as conditions dictate.

How much nitrogen should I apply?

My advice is to look back at the previous five to ten years and work out how much nitrogen your crops took up. All you need to calculate this are your previous yields and grain protein figures.

STEP 1: Convert fresh yield (t/ha) into fresh yields (kg/ha).	
Multiply by 1000	10 x 1,000 = 10,000
STEP 2: Covert fresh weight to dry weight.	
Multiply by 0.85	10,000 x 0.85 = 8,500
STEP 3: Convert grain protein into grain nitrogen.	
Divide by 5.7	13% ÷ 5.7 = 2.28%
STEP 4: Calculate the nitrogen removal by the grain.	
Multiply dry weight by grain N%	8,500 x 2.28% = 194kgs/ha
STEP 5: Calculate likely total nitrogen uptake by the crop.	
Divide by 0.68	194 ÷ 0.68 = 285kgs/ha

A proportion of this will come from background soil nitrogen with the remainder supplied by organic sources or fertiliser. Unless there are regular manure applications, grass leys or vegetable crops, the soil N level will not alter significantly. These figures can be compared to the amount of nitrogen applied to give you an

idea of the efficiency of use. Calculating an average over a number of years, along with the minimum and maximum levels, gives you a good framework to work with. It is then important to regularly monitor the crop development to see if it is a potentially high yielding year. One option is to use the LAI maps produced by our precision crop production division, SOYL. In 2014 their variably applied nitrogen customers achieved proteins 0.2% higher than our national average.

How do new varieties influence the amount of nitrogen needed?

For those growing the newer milling wheat varieties Skyfall and Trinity, their extra yield potential must be taken into account. An extra 1t/ha of yield at 13% protein requires the crop to take up 30kgs/ha of nitrogen; that equates to 50kgs N/ha of fertiliser based on the standard 60% efficiency.

When should I make my applications?

Most milling wheat growers use a three split fertiliser programme along with a foliar ear application. However, I think we should give serious consideration to a four split programme; this offers a number of benefits, especially in high yielding seasons. Firstly, it presents another opportunity to evaluate the seasonal conditions. Secondly, it will reduce the rate of the final application, allowing you to delay this until full flag leaf emergence for greater protein enhancement. Thirdly, it allows the final application to be omitted if conditions turn very dry, lowering yields and reducing grain protein dilution.

Is there any difference between fertiliser products?

The choice of product has an influence on grain protein. Urea based programs generally produce grain with lower protein than an equivalent Ammonium Nitrate program. This is due to the higher nitrogen losses from the volatilisation of ammonia. While this won't produce a significant yield loss, it will limit the protein production by restricting the available nitrogen. Applying urea early to cool, wet soils can lower the amount of volatilisation, but but the only way to significantly reduce it is to use ammonium nitrate or KaN (Agrotain treated Urea).

Late foliar nitrogen applications are also essential to achieve high grain proteins, but they can only raise levels by 0.5-1% so it is vital that they follow robust base programs. Foliar urea performance can vary significantly with weather conditions, but we've had very consistent performance from our more formulated product, Multi N.

Please remember that you must stay compliant with Nmax within the NVZ rules. In England the base Nmax for wheat is 220kgs N/ha for an 8t/ha yield. You can add 20kgs/ha for each additional t/ha over this yield, and an additional 40t/ha for milling wheat varieties.

What are the benefits of sulphur?

As well as nitrogen, make sure you supply enough sulphur to your milling wheat crops. There are three reasons this is important; firstly, it will help the crop to fully use the applied nitrogen for yield and quality. Secondly, along with nitrogen it is the main constituent of protein. Finally, recent trials work has shown it will reduce the risk of harmful acrylamide formation when bread is baked. Aim to apply at least 50kgs/ha of SO3 to your crops.

"With just 25% of milling wheat achieving top specifications, we must be better prepared to react to the season and manage our crops accordingly."

Edward Downing
Southern fertiliser technical manager

Sustaining soils; providing a vibrant growing environment for crop production

Due to intensive arable farming, the quality of many soils has declined and no longer provides the ideal environment for crop roots to fully develop to support greater yields. Mike Slater, fertiliser technical development manager, considers the characteristics of a healthy soil and looks at how we can begin to make long term improvements.

On many farms, it has been noticed that the horsepower required for cultivations has increased faster than the size of equipment, indicating increasing compaction and less friable soils. The combination of a fall in organic matter and the need to carry out field operations, especially harvesting, when soils are too moist has led to unavoidable compaction. Soils with good levels of organic matter will better resist compaction as well as facilitating greater microbial activity, leading to better nutrient availability.

Sampling

We regularly monitor soil nutrient status, sampling for pH, phosphate, potash and magnesium, but rarely are the physical parameters, especially soil density and microbial activity, measured. The key physical measures are soil density, porosity and organic matter levels. The workability of our soils is also greatly influenced by the ratio of sand, silt and clay in any one field; this can easily be measured by a simple laboratory analysis and will not change over time. Until now most soil textural determinations have been done by hand in the field and although a general classification can be achieved, it is very challenging to accurately define soil texture by this method.

Having a more detailed soil report covering physical, chemical and biological parameters means that we can then develop an action plan to address particular problems found in each field. This will require extra sampling and laboratory analysis but this information will be invaluable when developing improvement plans to support greater yields. An ideal soil is around 50 to 55% sand, silt and clay; this gives the texture of the soil. The rest of the soil volume should be organic matter, soil flora and fauna, and equal proportions of air and water.

As soil density increases beyond the ideal for crop production, there is a greater risk of waterlogging. As soils wet up there is a greater risk of anaerobic conditions developing which can lead to nitrogen losses, a decrease in microbial activity and, if the conditions persist, root death.

Nutrient availability

Soils with good organic matter levels, generally 3.5% or greater, are more resistant to compaction. They will also sustain greater microbial activity and support additional mineralisation of nitrogen and sulphur in the soil, providing crops with more nutrients for production. An improved understanding of all these physical parameters will enable you to take appropriate action to improve crop yields.

The impact of pH on nutrient availability is also a significant factor, especially for phosphate which will be locked up in both acid (less than 6.2 pH) and alkali conditions (over 6.8 pH). Although we have measured pH in standard soil analyses for a long time, the impact on nutrient availability is rarely fully considered. Besides macronutrients, the pH status of soils has a major impact on micronutrient availability. Manganese is locked up in alkaline soils, with magnesium less available in acid soils, however boron is less available at both ends of the pH spectrum.

A good understanding of all the above parameters is the starting point for soil management decisions to be taken. It is the relationship between the physical, chemical and biological components that determines the true vibrancy of our soils. If the organic matter levels in our soils are too low, there will need to be a long term programme to steadily improve them. If straw is being sold with no arrangement for return of manures, not only will there be a loss of nutrients, especially potash, but organic matter levels will, at best, remain static. Manures, composts, and cover crops can all contribute to improving soil organic matter.

Healthy roots

Roots will only be able to access nutrients and water if they can fully explore the total soil volume. The table below shows the relationship between bulk density and root growth.

Soil Texture	Ideal density for plant growth (kg/l)	Densities that affect root growth (kg/l)	Densities that restrict root growth (kg/l)
Sands, loamy sands	< 1.6	1.69	> 1.8
Sandy loams, loams	< 1.4	1.63	> 1.8
Sandy clay, clay loams	< 1.4	1.6	> 1.75
Silts, silt loams	< 1.4	1.6	> 1.75
Silty clay loams	< 1.4	1.55	> 1.65
Sandy & silty clays	< 1.1	1.49	> 1.58
Clays (>45% clay)	< 1.1	1.39	< 1.47

Compaction

Where soils are compacted, it is important to minimise additional damage by improving timing of field operations, if possible, and also by ensuring that tyre type and pressures are appropriate for the conditions. Tyre designs have improved greatly in recent years and tyres can run at much lower pressures than in the past, but increased axle weights tend to negate the advantage of better tyres.

Where compaction is a problem, dig inspection holes to identify where the compacted layer is in the soil profile. This will enable equipment to be correctly set to remediate the damage. Cultivator tines should be set to run just below the compacted layer but if fracture to the soil surface is not achieved, the situation can be made worse; the effect being achieved by a subsoiler should be checked by digging down to ensure the compacted layer is being removed. For deep compaction a series of tines at difference depths may be required to resolve the issue. Good effects from subsoiling will only be achieved when soils are dry and in some autumns soils may not be dry enough to justify subsoiling. In some situations where compaction is very deep, the costs of removal will be high and not cost effective. In this case, a different, longer term approach of using deep rooting cover crops could be the better solution.

Soil reports

A comprehensive soil report covering physical, chemical and biological parameters is an excellent way to evaluate the current condition of soils and also to examine the options for improvement. Once problems have been identified and improvements decided upon, an agreed action plan can be developed. Often the decline in soil quality occurs over many years and remediation can also be a long process, but the sooner improvements are begun, the sooner the benefits of a vibrant and active soil will be seen in improved crop yields and margins. Healthy crops growing in healthy vibrant soils are easier to manage and more profitable.

A good understanding of organic matter content, pH, nutrient availability and compaction is the starting point for soil management decisions."

Mike Slater
Fertiliser technical development manager

Looking to liquid for accuracy and efficiency

More growers are considering liquid fertiliser to supply nitrogen and sulphur. It offers the dual benefits of increasing yields through accurate application, and improved working efficiency. Bernie Zahra, liquid fertiliser manager, examines the practical considerations for those thinking of making the switch.

Accuracy

Liquid fertiliser applied through a sprayer delivers an instant improvement in nutrient application accuracy due to several factors:

1. The rate is accurately applied across the full boom width, no matter how wide. The coefficient of variance is less than 5%; uneven application can result in yield losses, which in turn can lead to significant financial penalties.
2. The full rate is applied right to the field margin or around obstacles, but not into any unwanted area
3. Overlaps at the end of bouts are reduced.

The result is more even crops, with less risk of lodging and overall higher yields as the field margins receive the full rate of nutrient; especially important with wheat prices at £110-115/tonne. Accuracy at the boundary also ensures that the product is not being applied into environmentally sensitive areas.

Efficiency

Working accurately at wider bout widths delivers the main efficiency gain, with applications being completed more quickly. Additionally, fast fill pumps reduce loading times. You also have a greater number of potential application days, as liquid is much less affected by the poor spreading days that can occur with solid fertiliser.

Other efficiencies associated with liquid fertiliser include:

- Labour and fork lift are not required for loading sprayer
- There are no bags to be disposed
- Unused product can be returned to the tank
- Low cost tanks free up valuable storage which can then be used more efficiently.

Nutrients

Liquid fertiliser products can be split into two groups; solution N, NS, NPK fertilisers and suspension N PK S Mg plus trace element fertilisers.

A full range of solution N and NS fertilisers is available to supply the nutrient requirements of different crops.

These homogenous solutions supply the full analysis in every litre of product. Urea Ammonium Nitrate (UAN) is the nitrogen source, supplying three sources of N to the crop. This delivers a balanced nitrogen supply; nitrate is available for immediate uptake, while the ammonium and ureic forms are available over a period of time. This also means there is less risk of leaching compared with solid AN. The sulphur content is in sulphate form so it is immediately available. Liquid fertiliser allows you to always apply some sulphur with the nitrogen, more closely matching how cereals and oilseeds use the two nutrients.

One practical consideration is the risk of causing leaf scorch. Weather conditions before and after application have the biggest influence; warm, windy conditions increase the risk. Modern application equipment, such as dribble bars which produce very large droplets, significantly reduces the risk.

Storage

To achieve the optimum benefits for your farm, the correct storage capacity and siting of tanks is essential. Our advice is that you should have enough capacity for a complete application. Tanks should be sited to minimise the amount of time needed to return and fill up; although it is simple to set up a bowser, facilitating work at a greater distance. Glass Reinforced Plastic (GRP) tanks are strong enough to handle the fertiliser weight and are corrosion free.

Your liquid fertiliser system should provide the best agronomic solution for your crop production needs, and offer practical efficiencies for your business. Take expert advice, tailor the set up to your farm and you will enjoy the accuracy and efficiency of a bulk liquid fertiliser system.