THE FERTILIZER ASSOCIATION OF IRELAND

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Horse and Jockey, Thurles, Co. Tipperary

Role of sulphur in yield, nitrogen use efficiency and reducing nitrogen losses in temperate grasslands
Claire Aspel

National fertiliser database
Bernard Harris & Finbarr O'Regan

Implementing technologies for improving the sustainability of tillage farming
Don Somers

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Contents

The role of sulphur in yield, nitrogen use efficiency and reducing nitrogen losses in temperate grasslands

Claire Aspel

Grassland AGRO
(research conducted at Teagasc, Environment Research Centre, Johnstown Castle, Co. Wexford)

Role of sulphur in plant nutrition

Sulphur (S) is an essential plant nutrient with important roles in crop productivity, quality, and nitrogen (N) use efficiency. Sulphur is of great importance for the primary structure of proteins and the functioning of enzymes. Sulphur is a constituent of the amino acids cysteine (Cys) and methionine (Met) and S limitation impacts N use efficiency. Although numerous roles of S are well acknowledged and improving N use efficiency is a major global challenge, S-focused research is relatively scarce compared to N and phosphorus (P) research, particularly for grasslands. Balancing S – N fertilisation holds potential for improving N use efficiency (NUE), minimising nutrient loss to the environment, and increasing plant productivity.

Reduced sulphur supply through deposition on agricultural soils

Despite its importance for agricultural crop production, S has received little attention for many years (Scherer, 2001). In recent years, diminished atmospheric S deposition as a result of stricter emissions regulations, decreased use of S-based fungicides, use of low S synthetic fertilizers, low S returns from farm manure, high nutrient demanding, high yielding crops, and intensification of agriculture have all led to a suspected increased prevalence of S shortage across the globe. There have been large changes in the global and regional sulphur dioxide (SO_2) emissions over the number if decades. After a steady increase in emissions in SO_2 since the beginning of the twentieth century, the growing awareness of the negative effects of air pollution on environmental and human health gave rise to international and national legislation on emission reductions. Therefore, before emission reduction S requirements of crops were being met mainly by the S deposited from the atmosphere and that released from applied livestock manures and soil organic matter (SOM). In recent decades, however, legislation has been introduced in many developed countries to reduce emissions of SO_2 gases into the atmosphere to migrate atmospheric pollution and acid rain. As a knock-on effect of lower SO_2 emissions, reduced deposition of S has reduced S soil supply (Scherer, 2001), in many developed countries, such as across Europe and North America. Engardt et al. (2017) showed decreased sulphate (SO_4^{2-}) concentration in precipitation from around the 1970s to about 2015 over Western Europe. European and North American SO_2 emissions were reduced by 70-

80% since the 1990s. Pollution action for acid rain demands cleaner emissions from industry thus, lower SO_2 in the atmosphere. In the UK the total emissions of SO_2 decreased from 3.2 million tonnes of S in 1970 to 1.4 million tonnes in 1995. Sulphur dioxide emissions in Ireland reduced considerably between 1990 and 2013. The latest estimates indicate a decrease of 86 % from 183.7 kt in 1990 to 25.4 kt in 2013 (EPA, 2015). Therefore, the reduced atmospheric S is thought not to be sufficient to meet the crop S demands hindering yield, quality, and nutrient use efficiency.

Increased sulphur requirements with farming intensity

At the same time, removal of S from agricultural systems in crops and animals due to intensified farming have increased. These trends for reduced S input and increased S removal from agricultural systems likely mean that soil S reserves, largely contained in OM in many soils are being depleted in many cases. Over time, this depletion may reduce the supply of plant available S to crops, leading to S limitation. The fact that crop deficiencies of S have been reported with increasing frequency over the past several decades' (Steinke et al., 2015; Carciochi et al., 2016) likely reflects this and would suggest that greater attention should be focused on the importance of this element in soil and plant nutrition.

Close links between sulphur and nitrogen in plants

In plants, S and nitrogen (N) play a synergistically central role in the synthesis of proteins. The supplies of these nutrients in plants are interrelated (Jamal et al., 2010; Gallejones et al., 2012). Sulphur requirement and metabolism in plants are closely related to N nutrition, and N metabolism is also strongly affected by the S status of the plant. Sulphur and N assimilatory pathways are also intertwined, with the abundance of one element modulating the other (Anjum et al., 2012). Thus, for optimal use of added N, S addition to the soil becomes essential in many circumstances. Limiting S supply to crops can depress the utilization of available soil N, potentially leading to increased N losses, such as nitrate leaching (Aspel et al., 2020; Brown et al., 2000). Sulphur and N have also been established as essential in terms of dry matter (DM) accumulation and yield in various crops (Jamal et al., 2010; Pagani et al., 2012) and also in grasslands (Mathot et al., 2008). Furthermore, significant interactions occur between N and S which influences N accumulation in the plant. Salvagiotti et al. (2008) showed an S x N synergism in wheat since the addition of S boosted N uptake as N fertilizer rates increased.

Increased environmental awareness in grassland farming systems

Grasslands are one of the major ecosystems of the world, covering close to one-third of the earth's terrestrial surface. In Europe, grasslands covers about 33% of agricultural area. In temperate climates regions such as Ireland and New Zealand intensive dairy, beef and sheep production systems are primarily based on pasture grazing (Dillon et al., 2005). Recent expansion and intensification, particularly of dairy systems has raised major concerns related to the increased loss of N, mainly N_2O and nitrate (NO_3^-) leaching to the wider environment associated with increased fertiliser use and larger herd sizes (Hoekstra et al., 2020). Burchill et al. (2016) estimated the average grass based livestock production systems to have a low nitrogen use efficiency (NUE) (<30%) resulting in large N surpluses that are vulnerable to loss. Therefore, it is important to assess the S requirements of grasslands.

For economic and environmental reasons excessive N fertiliser input to cropping systems must be avoided. Although a high N fertiliser supply may increase yield, it negatively affects plant NUE and hence reduces the economic benefit of the fertiliser. Losses of fertiliser N to the wider environment may contribute to an increased risk of eutrophication of surface and coastal waters and degradation of groundwater quality via NO_3^- leaching, and global warming by nitrous oxide (N_2O) and ammonia (NH_3) emissions. Countries face the joint challenges of food security and environmental degradation. However modern agricultural systems are always associated with substantial N loss through hydraulically and gaseous pathways (Quemada et al., 2013). Correcting S deficiency on S deficient soil has the potential to improve NUE and reduce NO_3^- leaching while improving productivity.

Yield response to sulphur applications in grassland

This work presented here focuses specifically on S effects in grassland examining the soil, plant and environmental loss response to S fertilisation on a range of temperate grassland soils using the soil lysimeter facilities at Teagasc Johnstown Castle. Yield response to S fertilisation was found to be related to soil texture, with yield responses of 31-51% (+ 3939 kg DM ha^{-1}) in the sandy loam soils compared to as little as 4% (+ 482 kg DM ha^{-1}) in the finest textured soil. Sulphur fertilisation increased N uptake across all soils, however there was a large range in this increase, from 14 kg N ha^{-1} extra uptake (finer textured soil) to 61 kg N ha^{-1} (coarser textured soil). On average, application of 46 kg S ha^{-1} to these soils increased yield by 2609 kg DM ha^{-1}.

For the treatments including slurry, the addition of mineral S significantly increased the annual yield indicating that the 9 kg S ha^{-1} present in the single slurry application (22 t ha^{-1}) was not sufficient to meet the crop S demand and or very poorly available due to much of it being in organic forms. In this study, plant S uptake was not significantly different when comparing CAN (9 kg S ha^{-1}) to the Slurry+CAN (10 kg S ha^{-1}) signifying low S availability in slurry. Applying mineral S with cattle slurry also significantly reduced leaching.

Effect of sulphur on N-leaching

Sulphur application brought NO_3^--N concentrations in leachate that would otherwise have been above the maximum allowable concentration for drinking water to below that level. Finally, the effects of different N and S fertilisation rates on NUE, leaching, and yield were examined using a sandy loam soil. Large reductions in nitrate-N (NO_3^--N) leaching of 45-51% were observed in the sandy loams in response to S fertilisation with N fertilisation. The present work showed an N x S synergy since the addition of S increased both DM yield and N uptake of the crop while reducing NO_3^- leaching loss. Higher N application rates require higher S application rates to optimise NUE and plant productivity while also reducing NO_3^--N leaching.

Conclusions

Overall, results suggest that, in temperate grassland soils where S and N are co-limiting, S and N behave synergistically in terms of yield, N and S uptake and N leaching responses. This response appears to be most likely on coarser textured soils. From a management perspective, assessing and if required, correcting S deficiency should be the first step before increasing N rate to boost plant performance; a strategy which can result in higher NUE and lower N losses to the environment. Overall, results suggest that S should be considered as an important nutrient for the efficient production of grass in temperate grassland soils with significant potential to reduce environmental losses, particularly through NO_3^- leaching in coarse-textured well-drained soils. The findings of this work point to significant potential for optimisation of S fertilisation to boost yields and NUE while reducing NO_3^- leaching.

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Implementing technologies to improve the sustainability of tillage farming

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Introduction to the farm

Don Somers runs a tillage farm in Oylgate Co. Wexford and farms 178 hectares collaboratively with his uncle James. Don grows mainly winter and spring cereal crops with break crops such as oilseed rape and beans. Don farms 97 hectares in total which consists of 83hectares of owned land and 14 hectares of rented or leased land. All the land farmed is within a 5 mile radius of the farmyard in Olygate. Soils range from free draining soils to heavier soils hence the farm is suitable for a wide range of tillage cropping. Crops are established using minimum tillage since 2018 which helps to reduces costs, increase field work rates and improve soil health. Both Don and James have a large focus on soil health which is the basis for high grain yields and maximising crop margins in a sustainable manner. Don is also participating in the Teagasc Signpost Programme which aims to demonstrate and implement climate smart options to reduce nutrient losses to the environment.

Crops, Rotations & Markets

A range of quality cereal grains, oilseeds and beans, which are mainly for the Irish feed market, are produced annually. Break crops are grown and bring additional advantages of higher yields in the following cereal crops. For example winter wheat can yield up to 1.5t/ha more following break crops such as oilseed rape. Nitrogen fixing crops such as spring beans reduce the overall chemical N requirements on the farm and can result in up to 30 kg N/ha residual N in the soil, thus reducing the following crops chemical N requirement. A typical crop rotation on the farm would be (1) winter oilseed rape or spring beans, (2) winter wheat, (3) spring barley, (4) winter oats, (5) winter wheat and (6) winter barley. Implementing a good crop rotation brings many benefits including reduced farm fertiliser N requirements, reducing pesticide inputs, soil health improvements and increases N use efficiency on this tillage farm. Break crop selection is dictated by soil type, where the break crop fits in the rotation and soil conditions at the time of drilling.

Soil Fertility status on the Farm

Over the last decade and half, building soil fertility has been a major focus on the farm as good soil fertility is key to maximising grain yields and has been a priority area of investment on the farm. Don said “soil fertility is a must on an intensive tillage farm for improve N use efficiency and reduce N losses”. Improvements made in soil fertility have resulted in production of high yielding crops. With current high fertiliser prices, good soil fertility (see figures 1 to 3) allows the tailoring of crop P and K applications based on up to date soil fertility levels and crop type, thus reducing costs.

As part of the Teagasc Signpost Programme the farm has been intensively, soil sampled on a field-y-field basis. Prior to joining the programme, Don said “I have worked closely with my tillage advisor John Pettit to build up the supply of major soil nutrients such as soil pH, P and K. We believe regular soil testing is key in managing soil fertility especially at current high prices and provides the information to make key decisions on managing soil nutrients now and in the years ahead”.

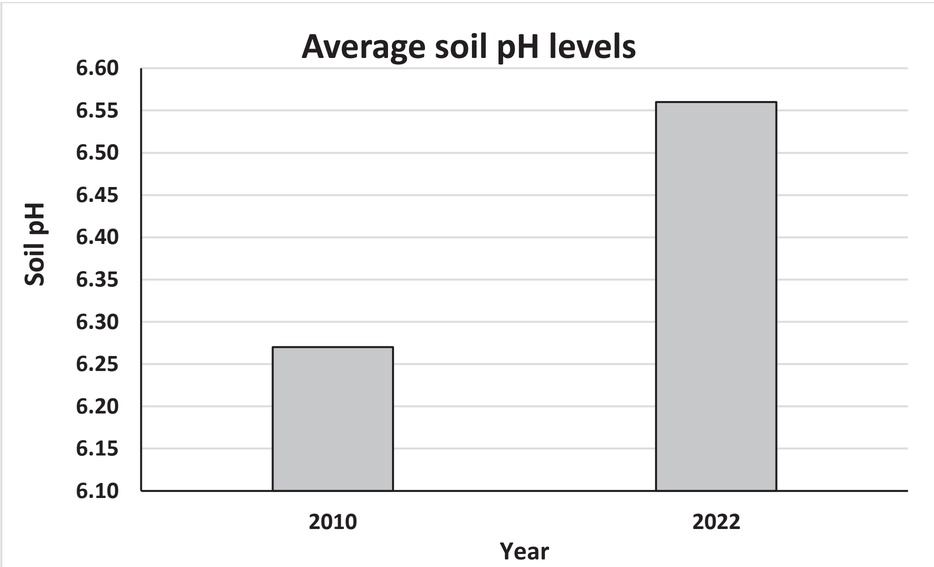

Figure 1. Changes in average soil pH levels across the farm over the last 12 years

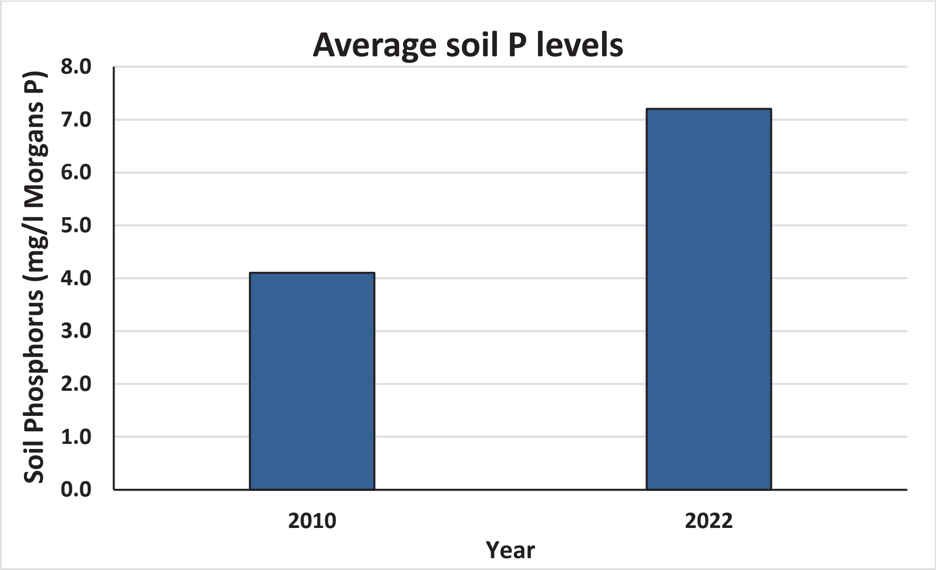

Figure 2. Changes in average soil phosphorus (P) levels across the farm over the last 10 years.

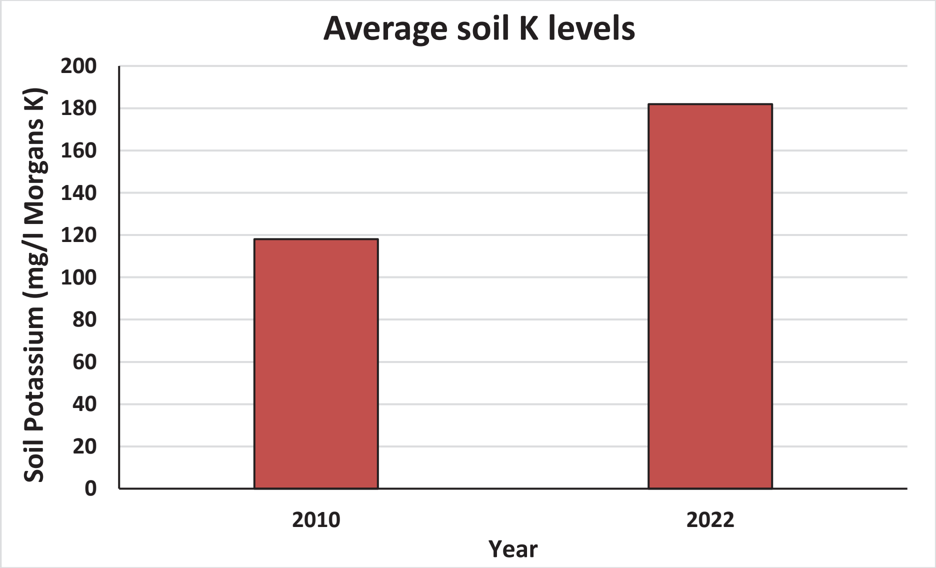

Figure 3. Changes in average soil potassium (K) levels across the farm over the last 10 years.

Improvements in soil fertility have been achieved over the long term with a combination of optimising soil pH, applying additional P and K to lift soil index levels, balancing P and K applications based on grain yields, the targeting of organic manure applications and the use of cover crops to mitigate against nutrient losses. The addition of organic manures add valuable nutrients plus soil organic matter which helps feed soil biology to improve soil nutrient supply and soil structure. Figure 1 shows average soil pH is currently close to pH 6.6 across the farm. Figures 2 and 3 show the status of soil P and K. Soil P on average has increased by ~ 3 mg/l over the last 12 years where an additional 10 kg P/ha was applied annually to build soil P levels to target index 3. Soil K levels have increased on average by 70 mg/l over the last 12 years through the application of additional K as Muriate of Potash.

Currently on average 76% of soils are at K Index 4 providing a great opportunity to reduce chemical K applications in 2023. Soil P levels are good with 48% of soil samples Index 3 or greater. In 2023, P and K application rates will be tailored further to balance crop and soil requirements. Don aims to move away from the typical N, P & K fertiliser blends and to apply more straight products such as Super-P and Muriate of Potash (MOP) in order to be more precise with P and K application rates. The field-by-field fertiliser programmes will be adjusted to take advantage of high soil reserves, especially K, and opportunities to reduce chemical fertiliser requirements for 2023 will be explored. The plan is to continue to maintain fertility at soil Index 3 and apply build-up rates of P and K to soils at Index 1 and 2 in order to improve overall fertility, efficiency and productivity.

Farm practices to improve soil fertility

a. Fertiliser planning – balancing P & K's

Over the last 15 years soil fertility improvement has been a key objective on the farm. Soil samples are taken on a regular basis and a farm fertiliser plan is prepared annually. Over the years optimising soil pH through the planned application of ground limestone with the aim to maintain soil pH 6.5 + for the crop rotation has been achieved. Soil P and K levels have been built up with a targeted approach to applying additional P and K's depending on soil type and crop P and K off takes based on field grain yields (see figures 1 to 3). Additional P and K has been applied using suitable fertilisers such as 10-10-20 and organic manures such as poultry manure, FYM and locally sourced dairy processing sludge. Figure 4 shows that 59% of soils are optimum soil pH, P and K this compares to 18% nationally for tillage farms. The aim over the next number of years as a Signpost farmer is to optimise soil fertility to 90% through continued fertiliser planning.

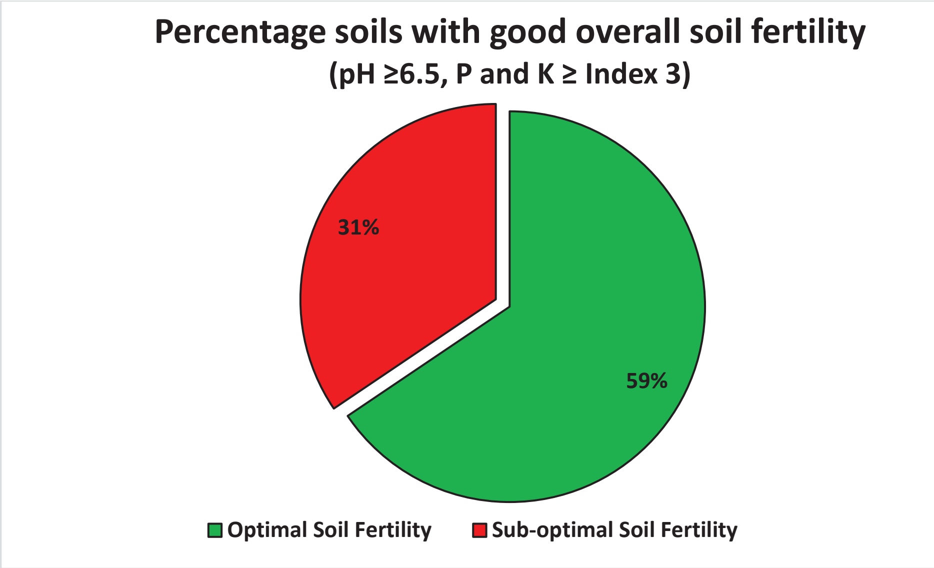

Figure 4. Percentage of soils with optimum soil fertility in 2022.

b. Organic manures

Over the last 5 years, a range of organic manures have been applied on the farm. Poultry manure is the main source of organic manures as it is a very suitable product for tillage crops with a good P and K ratio of 1 to 2.3. This manure balances crop P and K offtakes for cereal crops very well. Poultry manure nutrient density makes it a very suitable manure for cereal crops with typical application rates of 5t/ha. Manures are analysed before application to determine application rates depending on soil results and crop type requirements. The farm loader is fitted with a weight cell to accurately determine spreader load weights to further refine application rates. Manures are applied evenly across the spread width to ensure an even distribution of nutrients to the crops. Locally sourced dairy sludge which is a good source of slowly available nitrogen and phosphorus and is applied to help balance and build soil P reserves. Over the last number of years, straw has been traded for farmyard manure (FYM), which allows the recycling of nutrients locally. These manures add significant amounts of good quality organic matter, which is very beneficial to feeding soil biology. Table 1 shows organic manure results. Don said "that adding regular application of high carbon organic manures is improving the friability of our soils and I feel soils are easier to work during seedbed preparation"

Table 1. Organic manure types & available dry matter (DM %) and nutrient N, P, K based on manure analysis

	DM (%)	N (kg/t)	P (kg/t)	K (kg/t)
Poultry manure	50	21.2(total)	5.84	13.6
FYM	25	1.35	1.25	6

c. Chopped straw

On average over the last 2 years 53% of cereal & oilseed rape straw has been chopped on the farm. This adds another opportunity on an all tillage farm to add soil carbon and help feed soil life while improving soil structure. In recent years, the straw incorporation scheme has been very welcomed as straw provided a valuable income stream from animal bedding and mushroom compost. Straw is incorporated as soon as possible at harvest to 10cm to facilitate straw breakdown and incorporation back into the soil.

d. Soil Carbon

As part of the Teagasc Signpost programme soil carbon will be tested in the top 50 cm of soil. Figure 5 shows soil carbon results taken from the top 10cm of soil in 2021. The majority of soils are between 2 to 4% soil organic carbon which is similar to the national average with 80% of soil samples between 2 to 4 %. A number of practices on the farm such as applying organic manures, chopping straw and growing cover crops to help increase soil organic carbon levels. Nine percent of soils are at 0 to 2% soil carbon and are associated with lighter soils which have naturally low soil carbon levels due to soil type.

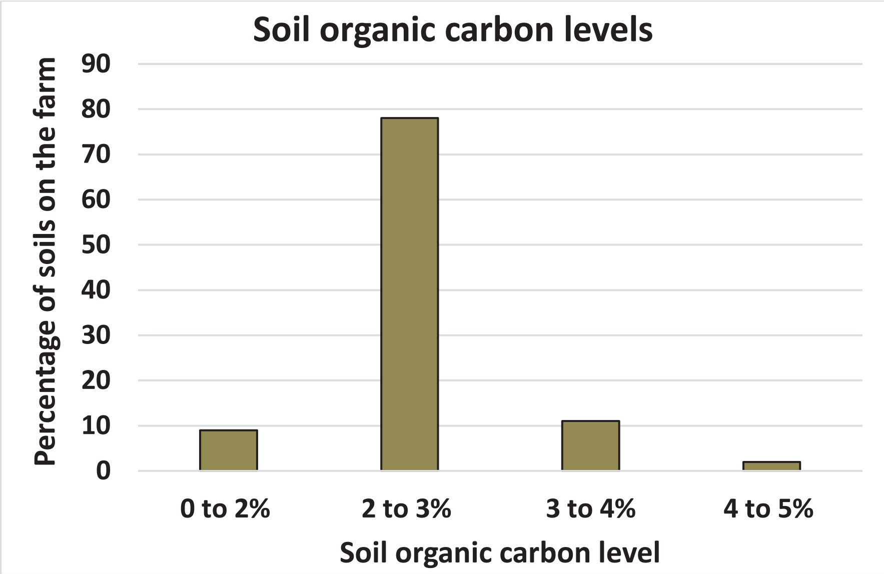

Figure 5. Proportion of soils in each soil organic carbon category to 10cm depth across the farm

Technologies to enhance N efficiency

a. Yield maps

Over the last 4 years grain yield maps have been generated for all the fields on the farm. This has provided very useful information on how different areas of the farm are performing each year. It has identified areas of fields that are lower yielding and the annual yield maps are showing differences depending on the season. See figure 6 showing the same field yield map for 2020 and figure 7 for 2021 where different yields were recorded. Remedial actions including targeted soil drainage, sub-soiling compacted areas and targeted application of organic manures have been conducted in recent years based on field grain yield maps.

Field yield maps were used to complete targeted soil sampling as part of the Signpost Programme to further investigate any underlining nutrient issues in lower yielding areas. Generally, results indicate that despite lower grain yields soil fertility levels are similar to the higher yielding areas, soil pH was one of the most variable nutrient differences. This indicates that other factors such as soil type, drainage and seasonal factors are having a greater influencing on final grain yields. It is a valuable tool in understanding yield differences from year to year and building up a field yield layer over time to help tailor in season application of crop inputs.

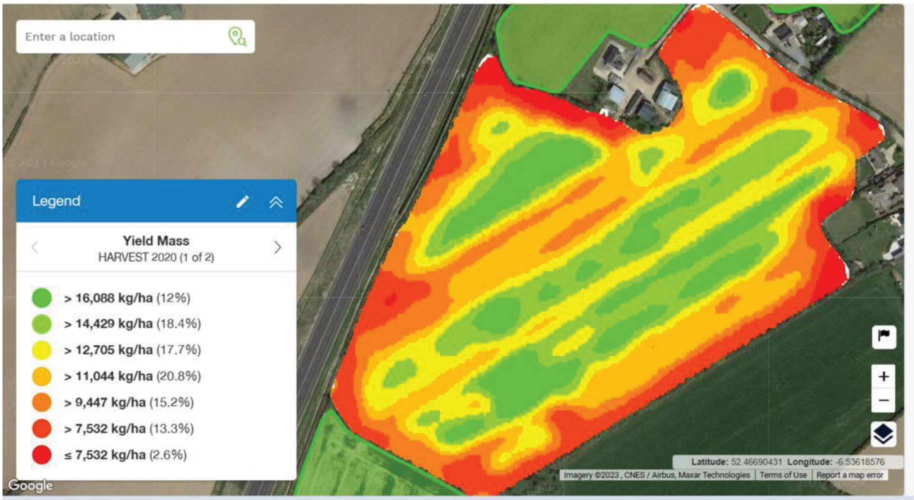

Figure 6. Field yield map for winter wheat in 2020.

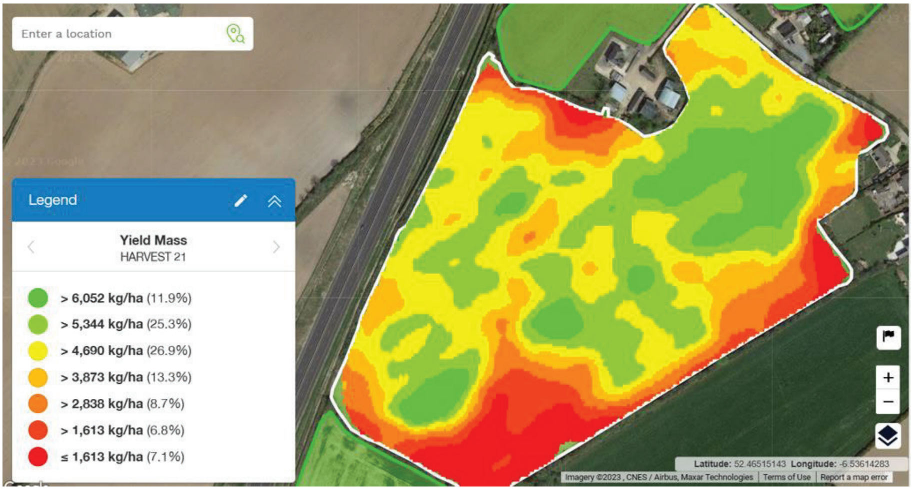

Figure 7. Field yield map for winter oilseed rape in 2021

b. Nitrogen sensor / mapping

To improve crop N utilisation based on in field variability crop N sensing was conducted on a number of test crops in 2022. An NDVI N sensor that measures plant colour as set up on the main fertiliser spreader tractor. Chemical fertiliser N was variable rate applied based on sensor readings during fertiliser N application. For the final N split 50kg N/ha was applied at GS33/ 37 to a field of winter wheat. The N sensor varied N rate from 42 to 65kgN /ha, a total of 189 kg N/ha was applied to the winter wheat in 3 splits. Figure 8 shows the Green Area Index map measured for both fields at GS 31/32. Before harvest grain sampled were taken from different parts of the field based on the NDVI map for both crops. Figure 9 shows the final grain yield maps where the average grain yield was 11.7t/ha and within field yield ranged from 9 to 13t/ha. Grain proteins varied across the field from 7.08 to 8.44% with an average grain protein of 7.82%. The N efficiency was calculated as shown in table 1 at 89%. Soil N supply was not measured and assumed at ~ 50kg N/ha. The crop calculated N efficiency is well above the national average of 65% for tillage crops in Ireland. The autumn of 2021 was very favourable for winter crop establishment with well-established crops plus low winter rainfall reducing N losses over the winter period. A cover crop was grown and was incorporated into the soil before planting. = Cover cropping in combination with a good break crop and drier winter than normal resulted in reduce N leaching thus making more soil N available resulting in high grain yield and N efficiency.

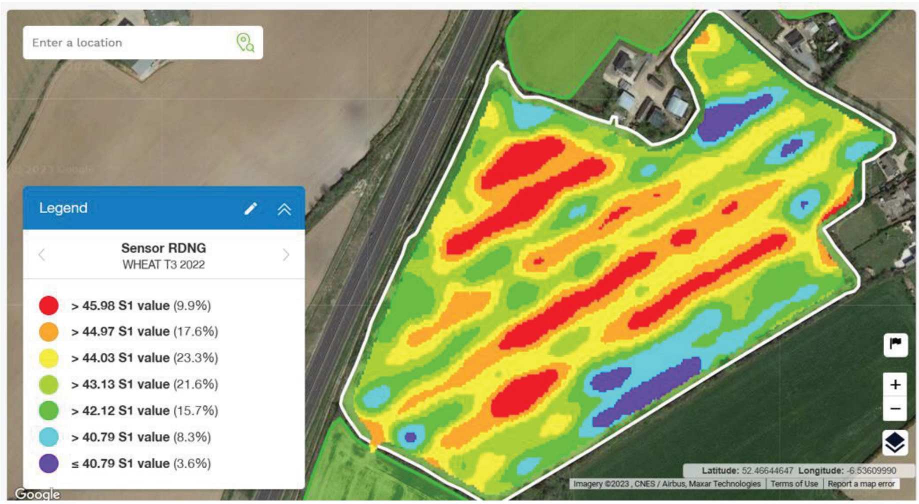

Figure 8. N-sensor map showing NDVI values on 6th June

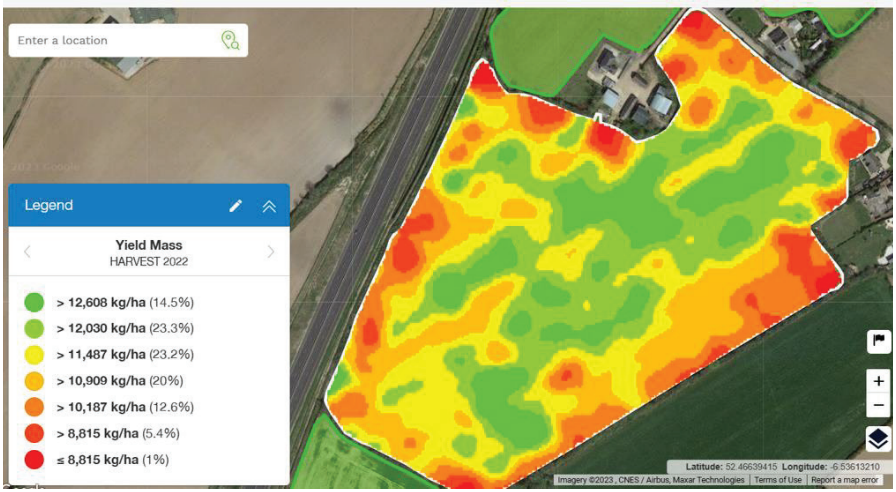

Figure 9. Winter grain yield map for variable rate N in 2022.

Table 2. Nitrogen sources, nitrogen offtake and nitrogen efficiency for winter wheat

W. Wheat Variety	Astronomer
Previous Crop	Winter Oilseed Rape
Soil N Supply (kg/ha)	50
N applied (kg/ha)	188
N Fertiliser Application Strategy	Variable Rate N
Average Grain Protein	7.82
Grain N %	1.37%
Nitrogen Efficiency	89%

c. Fertiliser types

High P and K compounds are selected to deliver required P and K rates in springtime for both winter and spring crops. Fertiliser types are based on soil and crop P and K requirements, for example high P and K fertilisers such as 10-10-20 have been applied to winter cereals at an application rate of 500kg/ha to deliver sufficient P and K. Additional K has been applied in the form of Muriate of Potash to build soil K levels based on soil and crop K requirements. Sulphur is applied at a rate of 15 to 25 kg/ha to meet crop S requirements and improve N efficiency for cereals and oilseeds.

The switch from CAN to protected urea was made due to rising fertiliser costs in the autumn of 2021. This resulted in a fertiliser N cost saving of €7,500 for the 2022 cropping season. Don said, “having a farm fertiliser plan prepared based on up to date soil analysis helped me make key business decisions in purchasing fertiliser in advance of the 2022 season. This has helped to maintain crop margins at a time when fertiliser prices were on the increase”.

Cover crops & soil health

Cover crops are now part of the farm crop rotation as they bring many benefits from adding valuable soil carbon, retaining soil N and P while also making soil more friable and workable. Cover crop species are selected based on crop rotation to avoiding brassica crop species as oilseed rape is grown in rotation and reduces issues with club root.

The aim is to sow cover crops as early as possible once crops have been harvested to maximise N uptake and cover crop dry matter production. Early cover crop mix consists of phacelia, vetch and clover. The phacelia is a rapid growing high biomass plant that will return a significant quantity of carbon to the soil and is very efficient at absorbing soil nitrogen. The vetch and clover being legumes offers the ability to fix nitrogen that will be of benefit to following crops. Later drilled cover crops comprise of oats, rye and phacelia. The plan is to use a low rate of oats in the cover crop mix, as it can be very competitive with partner species. Both oats and rye have the ability to establish well when drilled in late August or early September.

In 2021 as part of the Teagasc Signpost Programme a standard cover crop mix with a number treatments such as dairy sludge and with and without chopped straw were investigated. The autumn of 2021 provided very good conditions for the growth and development of cover crops. Cover crops were sampled in December 2021 to measure dry matter (DM) production and N uptake. Results for dry matter production and nitrogen uptake are shown in table 2 below. Cover crop dry matter yields ranged from 1.2 to 2.1t DM/ha and nitrogen uptakes ranged from 27 to 64 kg N/ha. Treatment no. 1 rye and phacelia mix with chopped straw had the lowest N uptake due to the chopped straw utilising available soil N in the straw decomposition process. This shows that chopped straw is very effective at utilising soil N after harvest. As an entry point for organic manures on tillage farms, dairy sludge which is high in organic matter and has a slow N release has been applied. The application of dairy sludge to treatment no. 2 showed an increase in N uptake of 6kg/ha indicating that the N is not readily available. Treatment no. 4 where straw was removed and no dairy sludge applied had the highest N uptake of 64 kg N/ha. This is due to the better firmer seedbed for cover crop establishment compared to where straw was chopped.

Table 3. Cover crop yields and nitrogen uptakes (kg/ha)

Treatment No. Cover Crop	Sowing Date	+ / - Straw	+ / - Sludge	Dry matter yield (t/ha)	Nitrogen Uptake (kg/ha)
1. Rye & Phacelia	1st Sept.	+	-	1.2	27
2. Rye & Phacelia	1st Sept.	+	+	1.25	33
3. Rye & Phacelia	1st Sept.	-	+	1.8	52
4. Rye & Phacelia	1st Sept.	-	-	2.0	64
5. Forage rape & Stubble turnip	Late-Aug.	-	-	2.1	52

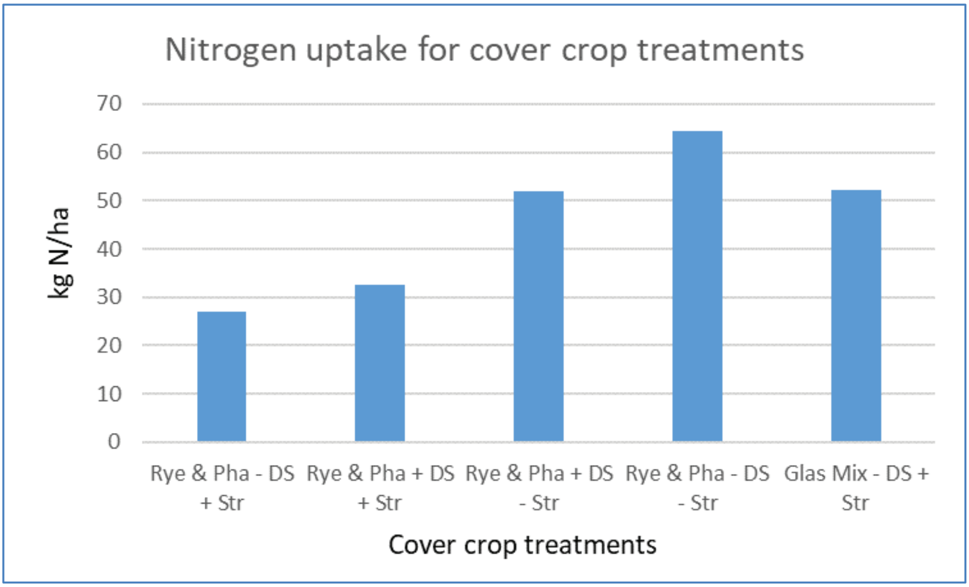

Figure 10. Nitrogen uptakes for planted cover crops in 2021.

Diversifying into Agr-Environmental schemes

Don has participated in previous environmental schemes including Rural Environmental Protection Scheme (REPS) and Green Low Carbon Agricultural Scheme (GLAS). An application has been submitted to participate in Agri-Climate Rural Environmental Scheme (ACRES) as the scheme is very attractive considering that a number of measures contained within the scheme including minimum tillage and cover cropping were already been practiced on the farm. To further enhance farm biodiversity the tree planting option was chosen. As part of the Signpost farm sustainability plan and ACRES requirements, hedgerows will be managed to further enhance there farm biodiversity value.

Conclusions

a. Responding to fertiliser prices

Intensively soil sampling the farm based on grain yield maps has provided an insight to in field variability for soil pH, P and K. Where significant variability exists within fields, nutrients will be applied separately to avail of savings where soil P and K levels are high. Organic manures such as FYM, poultry manure and dairy sludge will be utilised for spring crops as an alternative to chemical N, P & K. Nitrogen fertiliser will be applied in the form of Protected Urea to avail of a significant differential in the cost per kg of N in comparison to CAN.

b. Managing P and K Requirements

Based on recent soil analysis 76% of the farm is Index 4 for potassium. Applications of chemical P and K will be adjusted to take account current crop requirements, straw incorporation and planned organic manure applications. In 2023, 47% of fields will receive an application of chemical P while 37% of fields will receive an application of chemical K. The aim will be to maintain soil fertility levels in the optimum soil P and K index 3 to maximise N efficiency and crop yield potential.

c. Soil Health

Options such as applying organic manure, sowing cover crops and straw incorporation will continue to be implemented to add soil carbon to the soil to feed soil biological life and subsequently improve soil health. This will deliver better nutrient cycling; reduce nitrate and phosphorus losses to the environment. Soils will be more resilient to the effects of climate change events such as heavy rainfall events and summer droughts.

National Fertiliser Database

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Background

The Minister for Agriculture, Food and the Marine is in the process of introducing a Bill to amend the Fertilisers, Feeding Stuffs and Mineral Mixtures Act 1955 to provide for a National Fertiliser Database. The Bill also provides for the establishment of a register of Fertiliser Economic Operators and a register of Professional Fertiliser End Users.

Registration process

Under the proposed legislation, if a farmer or other Professional Fertiliser End user, for example a greenkeeper, wants to purchase fertiliser or lime, he/she must register as a Professional Fertiliser End User. Farmers or Agents acting on their behalf will be able to register using the Department's online portal www.agfood.ie; **this will be a very simple process.** Non-farmer Professional Fertiliser End Users will have to apply to DAFM for registration and once registered they will be assigned a unique identification number. Non-professional users of fertiliser will not be impacted by this legislative proposal. Professional Fertiliser End Users will have to submit stocks of fertiliser on their farms or premises on dates to be agreed as part of the consultation process.

Businesses or individuals selling fertiliser, must also register as a Fertiliser Economic Operator and will be required to submit information to the National Fertiliser Database. For example, when the legislation is in place each consignment of fertiliser leaving a merchant's premises for use by a farmer must be entered on the National Fertiliser Database. The timeframe for the merchant to provide this information will be set out in the secondary legislation once the Bill is enacted. This information can be submitted by the merchant through an Application Programme Interface (API) or through agfood.ie. The database will record physical quantities of product transferred to each fertiliser end user; it will not record any financial information.

Farmers or other Professional Fertiliser End Users that want to import fertiliser must also register as a Fertiliser Economic Operator and must comply with requirements on details to be uploaded to the database.

How will the National Fertiliser Database be used?

Once the National Fertiliser Database is established, DAFM will use the data to confirm farmer compliance with obligations under Ireland's Nitrates Action Programme and the Nitrates Derogation and Eco-Scheme agricultural practices. In time, checks that previously involved examining paper records will be completed using information from the database. This will significantly reduce the administrative burden that would otherwise be placed on farmers. DAFM will conduct risk-based on-farm inspections, as well as inspections at merchant level to confirm the accuracy of information being uploaded to the database.

DAFM is committed to an administratively simple system for Fertiliser Economic Operators and Professional Fertiliser End Users given the volume of fertiliser sales in Ireland.