

ISSUE 22 | JULY 2023

DIRECT DRILLER

MAGAZINE

THE FUTURE OF YOUR SOILS

Regenerative or Organic?

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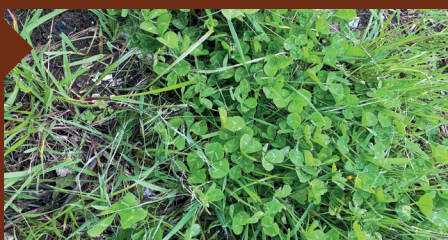


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DIRECT DRILLER

MAGAZINE

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INTRODUCTION

MIKE DONOVAN, EDITOR

Many farmers experiment with seed varieties, fertiliser, chems, machinery, target dates... looking for ways to improve results. Some farmers post their results on The Farming Forum and other media so others can benefit. Others join groups such as AHDB's Innovative Farmers Field Labs so specific problems can be answered. The Farm Innovation Programme from DEFRA is [to quote] designed to help farmers and growers with bold, ambitious ideas to step into innovation and build an expert collaborative team. The Nature Friendly Farming Network is a large group of farmers who run on-farm trials and share the results. In addition, experimenting plays a big part in the work of commercial companies, universities and environment groups. It can all seem a bit British and a bit random,

For many years I have called for greater organisation so projects and their results are easier to access and the work organised so it is not replicated and

research funding wasted. The idea may sound somewhat soviet but for farmers, researchers and even journalists, more organisation might provide useful results.

I now see how wrong I have been. Centralised farm research would result in directives and norms which would be difficult to ignore. One glance at the Irish Potato Famine and the reliance on farmers growing a single variety to feed the nation shows the dangers of everyone doing the same thing.

This Direct Driller issue has shown me some arguments for randomised research. It helps take into account the huge number of variables in any project. Soil types are just a start - the Agrii article submitted by their farm manager Dom Hughes is focussed on their heavy clay farm in Kent. Dom writes: "Nor should we fall into the trap of seeing transformations in performance as the result of one single management change"

Interpreting and applying research-based knowledge needs to involve the

variability of outcomes which central planning of research is likely to ignore. So maybe the British random system of farming research has its benefits! It certainly creates enthusiasm and application, as well as rivalry and competition.

Variability is a corner-stone of farm progress, and something to be cherished. Its benefits are seen on virtually every farm I visit, and so often it comes from the most unlikely sources. But we should not sit back satisfied. Farm education is lacking in business management which needs a higher profile and greater expertise.

Readers will sense the enthusiasm of our contributors through the excellent articles they have submitted, for which we are very grateful.



AGRICULTURAL REVOLUTIONS

WRITTEN BY CHRIS FELLOWS

Did you know we are currently in what is called the Fourth Agricultural Revolution? I've heard the phrase before, but I had to look up what the first three were. There is some variation, depending on what you read and where you live, but this is my summary of how the four main agricultural revolutions are commonly recognised in Northern Europe.

First Agricultural Revolution (Neolithic Revolution): The Neolithic Revolution occurred around 10,000 BC and marked the transition from hunting and gathering to settled farming communities. It involved the domestication of plants and animals, including the cultivation of crops such as wheat, barley, and rice, as well as the domestication of livestock like cattle, sheep, and pigs.

Second Agricultural Revolution (British Agricultural Revolution): This took place

in the 18th and 19th centuries in Europe and the USA. It was characterised by technological advancements and step-change improvements in agricultural yields. Key innovations included the use of crop rotation, enclosure systems, selective breeding of livestock, and the adoption of new tools and machinery (tractors, drills, combines were invented).

Third Agricultural Revolution (Green Revolution): The Green Revolution occurred during the mid-20th century, primarily from the 1940s to the 1970s. It was a period of significant advancements in plant breeding, agricultural technology, and farming practices. High-yielding varieties (HYVs) of crops, along with the use of synthetic fertilisers, pesticides, and improved irrigation methods, further dramatically increased crop yields.

Fourth Agricultural Revolution (Digital Revolution): The Fourth Agricultural Revolution is an ongoing process that encompasses the integration of digital technologies and data-driven approaches into farming practices. It involves the use of technologies such as precision agriculture, robotics, drones, Internet of Things (IoT) devices, artificial intelligence (AI), and data analytics. These advancements enable farmers to optimise resource management, make data-driven decisions, improve efficiency, and enhance productivity. The Fourth Agricultural Revolution aims to address contemporary challenges.

It's important to note that these categorisations are not rigid, and agricultural advancements have occurred in different regions and time periods.



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FEATURED FARMER

ANDY CATO



Colleymore is a National Trust farm that forms part of the Coleshill and Buscot estate. My family and I arrived here in 2021, having lived and farmed in France. Of the 295Ha, around ¼ is permanent grass. The rest is Grade 3 arable, predominantly clay. It shares the same characteristics as the clay soils we farmed in France - a very small window between being too wet to work and too dry to work!

In France, there were very difficult years both financially and psychologically as I tried to find ways in which to combine growing crops with turning around the heavily degraded soil, much of which had been reduced to 0.5% organic matter. I was doing so at the same time as learning the vast array of skills required to be a farmer, skills of which society at large is completely unaware and of which I was too at that point, coming from a family with no farming background.

As various cropping systems finally began working, I added value to our harvests through milling and baking. Eventually a farm shop served the local community, the farm hosted regular visits, and our customers were very engaged in supporting our farming practices.

Wildfarmed began as a collaboration with two friends from other walks of life completely and came from a conviction that we need these kind of field to plate supply chains at scale in order to create stable and fair prices for farmers, and engagement in the food system from customers. Both elements I believe critical if we are to create a food system that can address the environmental and health crises which we are confronted. There are now 55 farmers in the Wildfarmed community, which has taken on a life of its own and is a wealth of shared knowledge and agronomy support.

At Colleymore I'm treading a delicate balance between paying the rent whilst trialling different things which we might want to recommend to our growers. For example, plant diversity is an important part of the Wildfarmed Standards that we all follow. This requires cereals to be grown in the company of one or more companions. Wheat and beans or barley and pea are well-established combinations amongst many of our

growers. To refine these further, this spring at Colleymore we planted both using variable rates for the legume element, from 40% to 70% of the full rate. Last year we combined wheat with crimson clover and linseed, or barley with pea and rape. We're also working with perennial inter rows.

This is in fact where my polycropping began – the design of an inter-row mower to manage permanent pasture between crop rows. The mower went through many different versions and modifications before arriving at today's design. Several of our growers now have one built along the same lines and are using them to manage both annual and perennial inter-row combinations.



We operate on a 50cm centre strip till system, and have tried various drills over the past couple of seasons to plant these strips, from a Rapid with every other pair of coulters blocked off, to a Sprinter running a second (front) tank to deliver different seeds to every other leg. One of the headaches when doing this is symmetry, and in the case of the Sprinter, it required running the drill width at 575cm and installing a solenoid on the outer coulters that toggled on and off to keep alternating rows across the field. You'll see what I mean if you map it out with pen and paper!

American agronomist John Kempf often speaks about the enormous potential of seed drenching or inoculation, and Trevor Tappin's liquid applicator has moved around the different drills we have tried, to apply various biological brews at seeding.

When working with annual crop combinations, one question is whether there is any advantage in a strip layout that creates a kind of in-field rotation. i.e. drilling wheat and crimson clover strips in 25cm centred bands this year, harvesting both, and next year doing the same but with the wheat where the clover was. Given the interconnectedness below ground, perhaps this is over complicating things, and it would make no difference





to mix everything up and drill it together. I suspect the answer is the latter, but using the strip layout with the mower allows me to try different combinations of plants where I'm not sure the harvest dates will synchronise, knowing that I can manage the inter row strip if I need to.

The vast majority of Wildfarmed growers use single tank drills to plant their combination crops and ultimately the simpler we can keep the creation of a diverse environment in which nature can do the work, the better. From a Wildfarmed perspective, building a community of farmers all of whom are working with plant diversity in some form, has required creating an effective post-harvest infrastructure so that we can process the different crop combinations. From this harvest, we have teamed up with Robin Appel who have the capacity to separate large volumes according to size, colour, and weight.



We are working with Rothamsted's Andy Neal to further understand the changes in soil biology that follow increased complexity above ground, as well as running an experiment comparing glyphosate and tillage on the soil microbiome. We use Soilmentor to help track changes, and SAP testing to assess the need for any nutritional applications. There is so much to learn, and fascinating things to try. One of the joys of being part of a community is that we can learn so much faster.

We're always looking for new growers to join our community, so please drop Harriet a message for more information.: **Harriet@wildfarmed.co.uk**



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HOW MUCH DO YOU UNDERSTAND YOUR WEATHER FORECAST?

Written by Simon Keeling from WeatherWeb

"The bloody weather forecast has changed again!"; how often have those words passed your lips? It's a refrain that most in agriculture will be familiar with and is among of the most potent forms of frustration on the farm.

As forecasters, we hear that frustration too. Talking to farmers, growers and agronomists on our WeatherLive talk to a forecaster service, we all too often here, "When I looked at my app yesterday it said those showers would miss us".

You know the routine; you fire up your weather app, enter your postcode, and hey presto! Out pops the forecast for your farm; but does it?

What do you understand about how that forecast is produced? Is it really for your farm? And is it really worth you placing any confidence in weather forecasts at all?

By understanding a little more about where the forecasts you read, watch or listen to are coming from, you can make a better judgement as to how your farm is going to be impacted by the weather in the coming hours, days and (yes!) weeks and months!

Allow me to explain.

App forecasts for my farm

One of the most amazing innovations in recent years has been the development of the weather forecast phone app. The idea of getting an hourly forecast for your farm is a very tempting one. It's easy to be drawn in by sexy graphics and the implied accuracy of such predictions. However, one soon realises that all is not as it seems and the rain doesn't arrive when expected and the forecast changes from morning to evening updates.

This is because the telephone app is actually only extracting

information from data-points within a forecast model. That data point could be 20 miles from your farm, perhaps on the other side of a hill where climatic conditions are totally different. Entering a postcode to locate you is just giving the app a clue as to where to look for the nearest data.

Models update regularly (usually four times each day) and they cannot 'see' individual showers, or the tree line at the end of the field. These features can have a huge impact on a forecast and make the difference between your farm having a wet or dry day.

I would stress that this is not a reason to ditch the app forecasts, but it's a reason to treat them very cautiously and to use them only as part of a suite of tools for making more accurate predictions as to the weather on your farm.

Alternatives to the app

Of course you don't need to use phone apps to find out what the weather will be. There are many websites which will also present the data for your farm (or at least they claim to do that) and present it in an easy to use format.

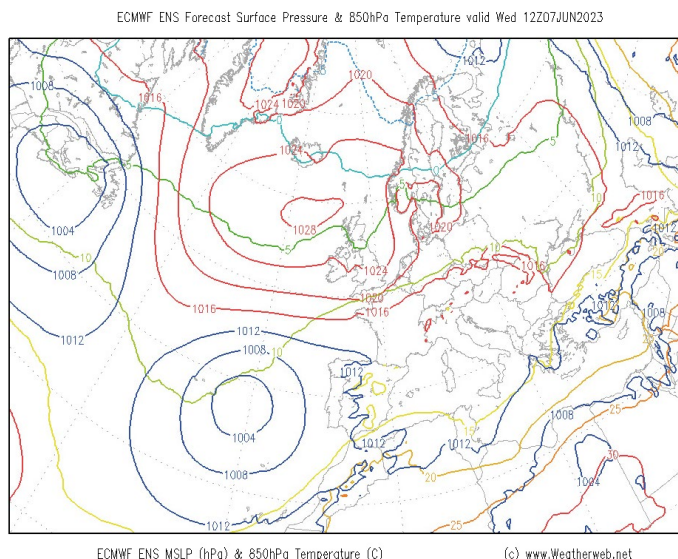
The same caveats apply here; sexy graphics don't necessarily mean better forecasts. Different runs of the models can produce widely differing results, and one should view the various updates as a matter of building confidence in the persistence of a forecast, rather than a single insight into what weather might ensue in the coming hours.

You will notice that the forecasts above are purely based on output from models. The wide variation in models is where human forecasters enter the story. Human forecasters should add real value and expertise to the forecast, being able to decide on which model, in which circumstances is likely to produce the most accurate story.

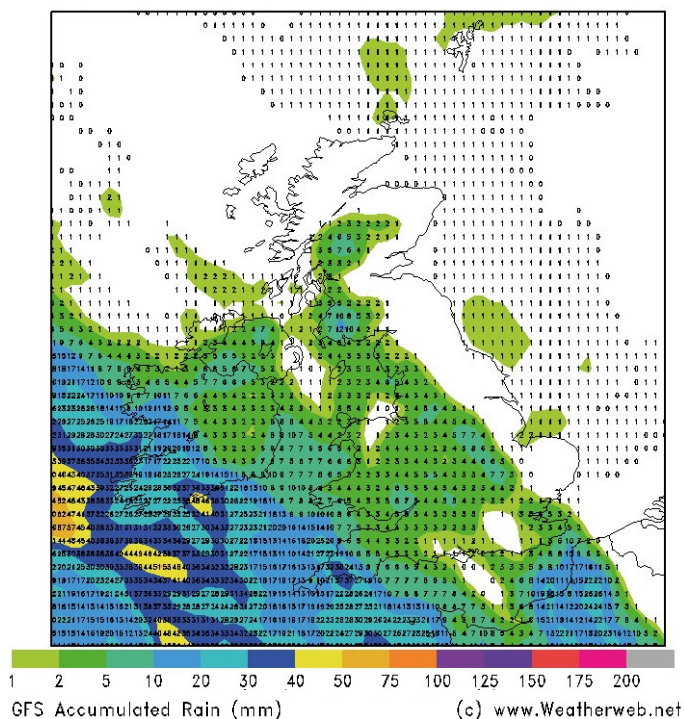
These forecasts are then presented on various websites and apps.

Weatherweb.net has been delivering forecast to farmers via email, phone and telephone conversations for over 20-years. We also operate our Weatherweb Premium membership service which gives farmers several video forecast each day from a few hours to weeks ahead as well as much more forecasting data.

Or check out our recently launched TFF Weatherweb channel at TFF TV. Here you will see out forecasters setting out the detail of what they expect the weather to be in the coming days, hours, weeks and months and, as importantly, justifying why they think the forecast will be as it is.



Accumulated Rainfall ending Sat 06Z10JUN2023



Building confidence

As I stated at the beginning of this article, the biggest frustration with weather forecasts occurs when they are constantly changing. All the user of the forecast wants to do is know that he or she can be reasonably sure that what is forecast will actually happen, and so the often expensive decisions made, will turn out to have been worthwhile.

Checking a forecast every few hours, especially in a changeable situation is a sure way to destroy any confidence we had in it.

Flitting between apps and models suggests that we are looking for the forecast we want to see.

In the medium to longer term (that's beyond about 5-days ahead) we should be looking at the forecast once a day; if the forecast stays the same each day we look at it, then that's a good indicator that we can be confident that is how the forecast will be.

For shorter term forecasts of less than 5-days, a look at the models twice daily should suffice. Again, if there is consistency then we can be confident in the forecast.

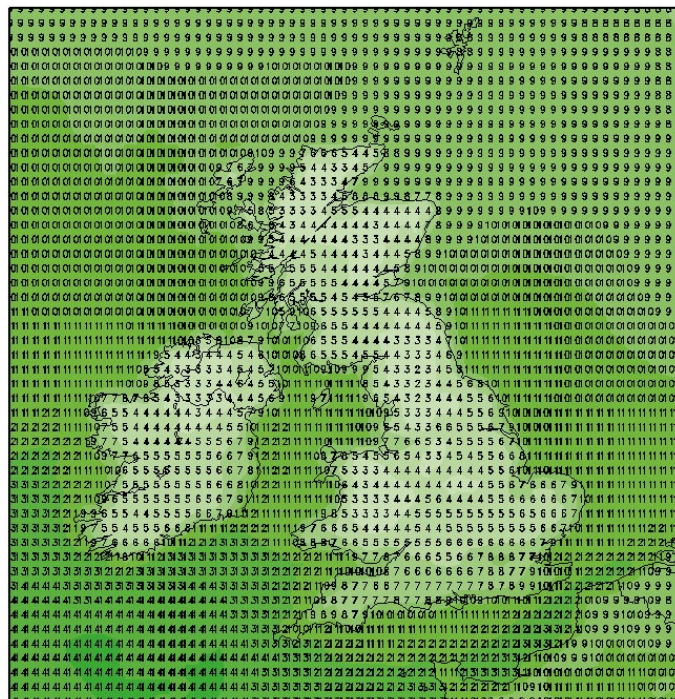
It's also important to be aware of the weather situation

and how the models handle weather. There is no way that a model can 'see' individual showers, and so the idea of using hourly forecasts for this is, frankly, laughable.

If more persistent rain is approaching then yes, it may be possible to predicted hourly as the rain system will be more widespread.

Applying these techniques to the forecasts you see will build your confidence in the information you are looking at.

GFS Forecast Min Temp 6hrs ending Mon 06Z29MAY2023



GFS Maximum temperature (C)

(c) www.Weatherweb.net

Accepting the forecast may be wrong

Remember that when we try to forecast what the atmosphere will do next we are dealing with a chaotic system. Forecasting has advanced rapidly in the last few decades, but forecasts can still be spectacularly wrong.

As a forecaster there are times when I have to sit back and accept that the atmosphere will do what it will do and be unpredictable.

Despite trying my very best there are times when you think you have Mother Nature cracked but then she turns around and bites you in the bum!

As forecasters and farmers, we have to be ready for that!

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THE MYTHS AROUND CARBON STANDARDS

With a growing number of farmers looking to evaluate their carbon footprint, Trinity AgTech's Anna Woodley provides some insight into the standards governing carbon and natural capital.



Anna Woodley, managing director of business development at Trinity AgTech

The carbon and natural capital space is rapidly developing and provides farmers with a real opportunity to make their businesses more profitable and sustainable. But when it comes to measuring and managing natural capital, how do you know which software to use?

According to Anna Woodley, managing director of business development at Trinity AgTech, the perception that there are no standards governing carbon is a misconception that leads to confusion when choosing the correct software solution.

"The trouble with the carbon space is there are no standards, so how do we know what system to use? This is a statement I hear on an almost daily basis, but the truth is there are a number of standards designed to bring order and credibility to the natural capital space.

"While the breadth of criteria for carbon reporting does vary with different standards, there are some international 'super standards' which verify the methodology behind carbon footprint reporting to the highest level," she explains.

These standards include:

- IPCC 2019 Tier 2 and Tier 3 - the most demanding tiers in terms of complexity and data requirements and sometimes referred to as higher tier methods. Tier 2 and Tier 3 are generally considered to be more accurate providing that adequate data is available to apply a higher tier method.

- ISO 14064-2 - quantification, monitoring and reporting of activities intended to cause greenhouse gas emissions reductions or removal enhancements.
- ISO 14067 - the quantification and reporting of the carbon footprint of a product, and the most comprehensive standard for carbon footprint reporting available.
- Publicly Available Specification (PAS) 2050 - specification for the assessment of the life cycle greenhouse gas emissions of goods and services. (PAS) 2050 has mostly been replaced by ISO 14067 and the GHG Protocol, however some retailers are still using it as a guide.
- Greenhouse Gas Protocol Product Standard - designed to understand, quantify, and manage greenhouse gas emissions.
- SBTi FLAG - SBTi's forest, land and agriculture (FLAG) guidance provides the world's first standard method for companies in land-intensive sectors to set science-based targets that include land-based emission reductions and removals. The guidance enables companies to reduce the 22% of global

greenhouse gas emissions produced from agriculture, forestry and other land uses.

Ms Woodley says: "Although these standards are not yet mandated, businesses operating in the food supply chain are increasingly making commitments aligned to these standards in a bid to cut out greenwashing and make credible progress on Scope 3 emissions, a significant amount of which sit at farm and fertiliser production level.

"SBTi and the Greenhouse Gas Protocol in particular, are two major standards that we are seeing increasing commitment to amid mounting scrutiny from investors and increasing reputational risk."

Ms Woodley says it is a risk for farmers and the supply chain to use information from software that doesn't monitor activities against these standards.

"We should be following the latest science to give confidence in on-farm reporting and credibly evidence our position and progress when it comes to protecting the environment.

"Software solutions that were credible a few years ago will no longer be relevant if they have failed to evolve with the science."

Ms Woodley explains that Sandy is the



Sandy in action

only proven software solution that covers all farm types and sizes that is accredited to all of these international standards.

"If you are using Sandy to navigate carbon and natural capital, you can trust that you're obtaining the most credible data possible."

She adds: "And the high level of sophistication Sandy offers, doesn't mean compromised usability. Sandy was built with farmers in mind, providing a user-friendly and intuitive platform that

accounts for carbon as well as all other farm natural capital assets."

Alongside carbon, Sandy contains modules for soil erosion, water quality and biodiversity.

"All of these natural capital assets have a value for farmers and should be considered holistically in conjunction with carbon.

"Co-benefits such as conservation management, increasing on-farm biodiversity, and protecting water courses

can bring more to the table in terms of environmental sustainability than simply focusing on carbon emissions targets. Sandy is the only solution to credibly evidence these benefits alongside farm planning and financial data all in one place," she concludes.

To find out how Sandy can help you measure, manage and optimise your farm's natural capital assets, head to www.trinityagtech.com/request-a-demo and request a demo.

What are Scope 1 emissions?

Scope 1 refers to a category of carbon emissions that includes direct greenhouse gas (GHG) emissions resulting from sources that are owned or controlled by an organisation. It is one of the three scopes defined by the Greenhouse Gas Protocol (GHG Protocol) for measuring and reporting emissions. Scope 1 emissions are considered direct because they arise from sources that are physically owned or operated by the farm.

These emissions originate from activities such as the combustion of fossil fuels, onsite fuel combustion, and emissions from processes. Common examples of Scope 1 emissions include emissions from vehicles, on-site power generation, heating systems, livestock and processes that release GHGs.

Measuring and reporting Scope 1 emissions involves gathering data on the amount of fuel consumed and applying the appropriate emission factors to calculate the total carbon dioxide equivalent (CO₂e) emissions. Emission factors represent the amount of GHGs released per unit of fuel burned and can vary depending on the fuel type and combustion technology used.

Reducing Scope 1 emissions is a vital aspect of sustainability and climate change mitigation efforts. Farms can achieve this by implementing energy-efficient technologies, switching to cleaner fuel sources, optimising operational processes to minimize fuel consumption and investing in renewable energy generation. Additionally, scope 1 on farms can be offset by your own sequestration.

By addressing Scope 1 emissions, organisations can take direct action to minimize their carbon footprint. It demonstrates a commitment to environmental responsibility, enhances operational efficiency, and aligns with sustainable business practices.

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What are Scope 2 emissions?

Scope 2 refers to a category of carbon emissions that includes indirect greenhouse gas emissions resulting from the consumption of purchased electricity, heat, or steam by an organisation. It is one of the three scopes defined by the Greenhouse Gas Protocol (GHG Protocol) for measuring and reporting emissions. Scope 2 emissions are considered indirect because they are generated by a third party, such as a utility company, but are associated with an organisation's activities.

These emissions arise when organisations use electricity, heat, or steam generated by external sources that release greenhouse gases during the production process. Examples of Scope 2 emissions include the burning of fossil fuels in power plants or the release of emissions from renewable energy generation.

Measuring Scope 2 emissions requires organisations to collect data on their energy consumption and multiply it by the emission factor associated with the electricity, heat, or steam used. The emission factor represents the amount of greenhouse gas emissions associated with the energy source, such as coal, natural gas, or renewable energy. Organisations can obtain emission factors from publicly available sources or directly from their energy suppliers.

Addressing Scope 2 emissions is an important aspect of corporate sustainability efforts and climate change mitigation. Organisations can reduce these emissions by transitioning to renewable energy sources, improving energy efficiency in their operations, and actively engaging with their energy suppliers to procure low-carbon or renewable energy options. Additionally, organisations can purchase renewable energy certificates (RECs) or engage in power purchase agreements (PPAs) to offset their electricity consumption with renewable energy generation.

By managing and reducing Scope 2 emissions, organisations can make significant progress toward their climate goals, contribute to a cleaner energy system, and demonstrate their commitment to sustainability and environmental stewardship.

What are Scope 3 emissions?

Scope 3 refers to a category of carbon emissions that encompasses indirect emissions resulting from an organisation's value chain activities. Scope 3 emissions occur both upstream and downstream of an organisation's operations, making them the most extensive and challenging to measure and manage.

These emissions originate from a range of sources that fall outside a company's direct control. Examples include emissions from purchased goods and services, travel, employee commuting, product use, end-of-life treatment of sold products, and even the extraction and production of raw materials used in the company's products. As a result, Scope 3 emissions can account for a significant portion of a company's overall carbon footprint, particularly for sectors with complex supply chains.

Measuring and managing Scope 3 emissions can be complex due to the multitude of actors involved and the need for data collection across the value chain. However, addressing these emissions is crucial for organisations aiming to achieve comprehensive sustainability targets and effectively mitigate climate change.

Companies can take various steps to address Scope 3 emissions. This includes engaging with suppliers to encourage emission reductions, adopting circular economy practices to reduce waste and emissions throughout the product life cycle, incentivizing sustainable transportation options for employees, and offering energy-efficient and low-carbon products to customers. Collaboration among stakeholders is also crucial to drive systemic change and reduce emissions collectively.

Understanding and addressing Scope 3 emissions is essential for organisations committed to tackling climate change comprehensively. By accounting for the full carbon impact of their activities, companies can develop effective strategies to reduce emissions and contribute to a more sustainable future.



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REPLACEABLE COULTER TIP TINES **REDUCE METAL WASTAGE** AND SO MUCH MORE!

Bourgault Tillage Tools UK have been working hard Over the winter months to develop a replaceable coultter tip tine option for a number of the most popular seed drills that are currently in the marketplace. The objective is to give greater versatility to the farmer whilst saving money in wasted metal and delivering great seed placement with minimal disturbance.



The replaceable coultter tip tine option is available for the following

- 1) Weaving Sabre Tine
- 2) Amozone Cayenna
- 3) Kuhn Migant
- 4) Most self builds with rigid tines.

The popularity of these seed drills has increased dramatically over the past few years. With the available grants and the seasonal variable weather patterns many farmers are turning to this design of seed drill where others fail. Some farmers are using these drills as their only seeding option, however many larger growers and contractors are using them as back up when larger disc drills cannot operate. With the self-build options, a neat self-weld on socket can be used to turn any vertical rigid tine into a replaceable coultter tip tine.

Weld on nose socket gives access to a wide range of replaceable coultter tips.



UK Trials

The initial thoughts about achieving a replaceable coultter tip tine was at groundswell 2022 whilst talking to farmers and listening to what their concerns were about these machines. Work started almost immediately in the design process. We knew that we already had a magnificent range of tips available to us from the BTT foundry in Saskatchewan Canada. All of these tips, their design and their manufacture is well proven and nothing new with millions of hectares of ground seeded globally with these products. The difficult bit was for Stuart Aldworth (Technical Manager BTT UK) And the design team to come up with a way off designing the replaceable tip tine whilst not detracting from the original manufacturers whole good design's and functionality. Primarily all that Bourgault Tillage Tools are interested in is the bottom 3 inches of any tine. Within two months a few replaceable tip tines were made and initial trials



First Trial Coultter Tip Tine, VOS 19mm Tip with fixed seed tube like the Amozone Cayenna.

could take place to prove the concept.

Through our farming contacts we were aware of a weaving Sabre tine that is owned and operated by farmers and contractors James and Chris Mizen from Love's Farm, Cutlers Green, Essex. We were also very aware that the ground that the Mizens farm was very heavy Essex clay which has extremely high wearing properties. The perfect place for a trial for the new replaceable coultter tip tine.

The BTT trial coultter tip and tine were put on alongside new Weaving OEM tines and did a total of 800 acres of drilling during the autumn and spring at Loves Farm, Essex.



Initial on farm photos for both the Weaving OEM Tine and the BTT Replaceable coultter tine and VOS 19mm tip.



Comparison Photos of Weaving OEM Tine and the BTT Replaceable Tine and VOS 19mm tip after 800 acres. Also, a photo showing the wear between the VOS 19mm (after the 800 acres) trial tip and a new unused VOS 19mm tip.

Mizen Trial Results.

From a wear point of view only, there is no doubt that the Bourgault Tillage Tools VOS replaceable tip and tine far out last the original OEM tine. The BTT leg element was also showing little or no wear which would indicate that the tine to tip ratio would be in the region of 6 - 8 to 1.

Points of note –

- 1) Some may say that the VOS 19mm TIP is too wide and would take too much pulling and would create too much disturbance?

In both cases this is not correct, the design of the tip and the angles used means that the soil flows very easily around the tip and that the nose of the tip being so far in front of the leg means that the tip acts like the bow of a speed boat cutting through water. In the soil this has the added benefit of creating less smearing on certain soil types and reduced disturbance compared to the very upright design of the OEM tines.

- 2) Is there an narrower option to the VOS 19mm TIP?

Yes – there is a VOS 13mm TIP option. Admittedly this would not give the same amount of wear as the VOS 19mm TIP purely because of the thickness of the point but it will

still well out last the OEM part.

Other benefits at the replaceable tip tine offers.

- Reduction on metal wastage by not throwing away the whole tine when it is just the tip that has worn out. You would not change a complete wheel if the tread on a tyre had worn out – you would just change the tyre, same principle. Saving Money.
- Less down time replacing tines. Saving Money
- Proven better wear rates due to the high Chrome material used in the cast of the tips . Saving Money
- Extra Long Tungsten carbide inserts for abrasive conditions. Saving Money
- Long nose design of the tip means better penetration and easier pulling. Saving Money
- Design also created more tip tilth, creating better soil to seed contact.

Final Tine Design

This final leg design is made from a Hardox Steel with Max Life extra protection on the tine shin and rear tine sides. The Max Life side protection also helps to protect the adjustable seed tube at the rear of the leg. All tips are held in place with the unique BTT stainless steel square

nut and bolt assembly which is used and proven worldwide.



Final tine design available from July 2023

To finish.

BTT UK have one Lincolnshire customer who has used the Bourgault Tillage Tools VOS (versatile Opener System) on his two Horsch Sprinters for many years and has ordered a Weaving Sabre Tine specifying that it comes with the Bourgault Replaceable Tip Tine Option.

Further information is available from BTT UK Ltd 01733 971971 or see us at both Cereals and Groundwell Events this Summer.

FARMER FOCUS

ANDY HOWARD



As I sit here on the last day of May writing this article it is blowing a gale outside and has been for quite a long time now. Our soils have gone from drenched at the beginning of May to having the life sucked out of them at the end of the month. It really has been a difficult few months. Watching crops struggle in wet places to not being able to plant our spring crops until very late. If you had asked me at the beginning of March, I would have told you the farm looks fantastic, now it doesn't!! Through these hard times we need to learn lessons and I will share mine.

On our heavy clay we need to do a lot of mole ploughing. The areas that have been moled twice and so the moles are only 1.5m apart looks great. Areas where it has only moled once to 3m width apart the crop looks wavy, good over the mole and poor in between. The areas that haven't had any moling and were due to be done last autumn but weren't as too dry, look poor. I'm hoping for some moisture this autumn as we have a lot of mole ploughing to do!!

We have also seen BYDV show up in some of our wheat. In the last 6 years since we stopped spraying insecticides, we have seen virtually none. There does seem to be a correlation between wet areas, spring SU usage and the variety Crusoe. I think the plant health has been compromised in these areas making them vulnerable to attack, mix that with high aphid pressure for months and the result isn't good. There are people who have sprayed insecticides locally twice, once in the autumn and once in the spring and still have BYDV so not sure there was much I could do about it. A certain amount I think is spring infection as it has only tipped the flag leaves, also I have found wild oats, meadow brome and even blackgrass with BYDV and these wouldn't have been there in the autumn.

Less of my mistakes and woes and onto some positive aspects of this year (I'll try). By the end of tomorrow I will have finished spot spraying Blackgrass in my wheat and grass seed. For me this is vital to allow me to keep growing crops like second wheats and herbage seed. Hearing lots of horror stories of a black grass mess across the country so at least we aren't too bad, and our seed return will be low.

My middle of May drilled Linseed (with oat companion) and

our Lentil/Camelina intercrop are looking well. We have a strip of Chickpeas in our linseed to try again for Hodmedods. There seems to be demand and a good price for them which is unusual for this year! They will soon start to suffer though with this constant wind. The Spring OSR/ bean intercrop has been a struggle. It was planted on Easter Sunday and didn't have the easiest month to start growing. Hopefully will get away now.



Linseed chickpea oat

Fingers crossed by my next article my mood may have improved and we have started a new season with some enthusiasm. It was worrying to see Clive's poll on Twitter where 60% of respondents would think or are thinking of quitting farming. Even though I don't feel that despondent I do understand the frustration. There seems a perfect storm of falling markets, high input costs, disappearing subsidies and government/public disdain of farming. Those issues are frustrating but the one that annoys me the most is the weather; we don't seem to be able to go a season without a major issue. Last year was 40 degrees during flowering of the spring crops, this year seems to be months of wet followed by very drying weather. I am trying to make our system resilient, but it is very difficult in these extremes. I guess I should be thankful that I'm not a fruit, vegetable, or pig farmer this year, there is always someone else worse off!!

Look forward to seeing you all at Groundswell, I will be there for the 2 days wandering around and on the Groundswell Agronomy stand.



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FOLIAR NITROGEN

Written by Mike Abram

As more growers use foliar nitrogen applications, Direct Driller picks out some practical tips about how to formulate mixtures for maximum efficacy from Joel Williams' masterclass



Joel Williams

Foliar feeding potentially offers a more efficient and quicker route to get nitrogen into a crop, particularly later in the season, but it does come with some risk, such as scorching leaves and from inconsistent results.

Minimising those risks comes from paying close attention to formulating applications correctly, suggests Integrated Soils' Joel Williams. Earlier this spring he put together a lecture series providing detailed information and advice about how to maximise foliar nitrogen applications.

Most foliar nitrogen applications are based on urea, which has a number of advantages, he says.

First, urea is much quicker to be absorbed into plants because of its neutral charge than ammonium or nitrate. That's important to optimise the plant's health and nutrient status compared with soil applications, which are generally slower to move into the plant.

"We can get foliar into the plant much quicker than soil-based applications," Mr Williams says.

Amino acids are generally even quicker to get into a plant, but urea is attractive because of a lower cost / unit of nitrogen than amino acids.

"There's also an interesting review that suggests urea is a good chelator – when you mix it with other nutrients it improves the uptake of those nutrients, especially trace elements, such as zinc and iron."

If making your own foliar urea on farm by dissolving granular urea in water, remember this is an endothermic reaction – in other words in the process of dissolving pulls in heat dropping the temperature of the water significantly.

"As the temperature drops, it becomes harder to then solubilise the rest of the urea, so any strategies you can use to increase water temperature will be help."

That's probably not going to extend to paying energy costs to warm water, Mr Williams says, but if you're using any kind of below ground water source, pumping it to the surface can help warm it. Likewise, storing water in a black tank in the sun for a couple of days before use will also help warm it up by a few degrees.

"That can make all the difference," he says.

The other key thing when solubilising urea is keeping the water circulating, especially at the bottom of the tank, while feeding the urea in slowly. "I know some farmers are putting all the urea in at the same time and making it work, but slowly feeding it in minimises the risk of clumping and settling at the bottom of the tank."

Optimising foliar urea applications is much more than just spraying dissolved urea, however, he stresses.

He recommends a number of other additions to the tank.

"On top of foliar nitrogen, it's also about all the other nutrients that work with nitrogen, particularly the trace nutrients and some of the macronutrients, like sulphur, potassium and magnesium that work with nitrogen to support its movement through the metabolic pathway and its role in growth and protein development.



Picture taken by Tommy Tierney

"So in a nitrogen strategy, we have to think about the other nutrients."

Nickel, for example, is critical for urease to break down urea, while molybdenum, sulphur and iron are important for the nitrite and nitrate reductase enzymes to break down nitrate into ammonium. Manganese and magnesium are crucial for amino acid production, while a whole range of minerals play a role in converting amino acids into proteins.

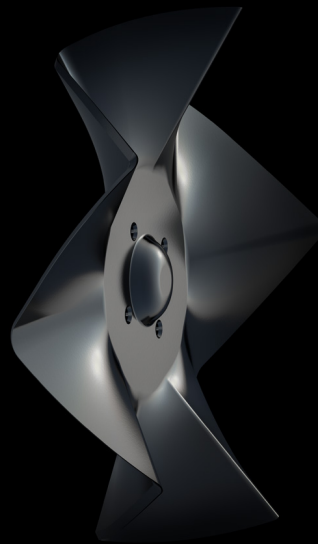
If there is a deficiency of any of these key minerals it potentially can cause a backlog of nitrate or ammonium to build up with consequences for plant health, Mr Williams explains.



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Where farming starts

A plant sap or tissue analysis can help determine whether these or other nutrients are required, he says.

Mixing the nutrients with a carbon source helps bind the nutrients. Carbon acts as a sponge for positively charged nutrients, enhancing uptake and improving the permeability of the plant cells.

"They will be less reactive, less likely to lock up with other nutrients in the tank, and in the case of urea, less likely to volatilise off the leaf surface."

Humic and fulvic acid are the most common organic chelators. For foliar applications, Mr Williams prefers fulvic acid as it is a smaller molecule that will pass into the leaf more quickly.

Another reason is humic acid is only soluble under alkaline conditions, which with a target spray pH of 5 or 5.5 there is a risk of it jellifying in the tank, while fulvic acid remains in solution at all pHs.

Other potential carbon sources include molasses and do-it-yourself sources of amino acids, such as fish or other protein hydrolysates. Molasses is less effective at chelating nutrients, but has other beneficial properties, he says.

Studies have shown that applying molasses stimulates microbes to digest nutrients, converting them into a stabilised form in their bodies, which are then recycled over a slower time frame.

Amino acids, on the other hand, are a

very efficient form of getting nitrogen into plants, as they are further along the pathway to being converted into proteins.

"It's sometimes beneficial to use a diversity of carbon sources with different modes of action and roles," Mr Williams suggests.

Other useful additives in the spray tank include wetters, stickers or spreaders that can beneficially modify the behaviour, activity or availability of the nutrients.

Water conditioners, such as ammonium sulphate or citric acid that help make sure the spray solution hits the target acidic pH for optimal absorption of nutrients should also be added where required, Mr Williams adds.

With multiple additives and nutrients in the tank, do a jar test to check compatibility, he advises. Soluble forms of calcium can be problematic, for example, especially with sulphur and phosphate as it can precipitate out, he concludes.

What causes scorch?

Scorching of leaves is a common problem with foliar urea applications, and the primary cause is either an excess of urea or ammonium in the leaf, Mr Williams says.

If the pathway which converts urea into ammonium or ammonium into amino acids is blocked that can lead to

a build-up urea or ammonium in the leaf causing toxicity, he explains.

There can be various reasons behind this, from a lack of key nutrients to build the enzymes to convert urea or ammonium, over-applying of urea or ammonium, or environmental conditions slowing the enzyme activity.

Biuret, a contaminant in urea manufacture, can also contribute to scorch, albeit more in perennial crops where it can build up over time than annual crops, Mr Williams notes. "If it is 1% or less then it is a good source for foliar spraying."

Additions of nickel, manganese and / or magnesium sulphate can help facilitate the conversion of urea to avoid scorch, as can applying foliar sprays in high humidity, and avoiding spraying on bright sunny days, in windy conditions or in low temperatures.

"Whenever we have a low metabolic rate in the plant, whether it is from environmental stress such as low temperatures, drought stress or herbicide injury, that is when urea or ammonium can build up and cause potential toxicity."

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PROVING THE VALUE OF CONSERVATION AGRICULTURE IN THE UK

Written by Joe Stanley from the Allerton Project

What it is to be 'a good farmer' in the UK is currently undergoing a transformation of grand proportions. Many will have spent much of their careers in the belief that farmed land was for one thing only – food production – and that soil health (to the extent that it was considered at all) consisted primarily of phosphate, potash and lime indices. To be complimented on a big yield and tidy field was perhaps the greatest accolade from one's peers.

Today, much more is being asked of farmers - and the land we farm. Food production is now on an almost equal footing with 'natural capital services' such as clean water and climate mitigation strategies, while farmers are navigating a new world of organic soil and carbon, nature restoration and baselining.

At the Allerton Project, we have been at the forefront of such work since we first opened our doors in 1992, and are fortunate to employ our own full time team of research scientists who carry out continuous investigation and development of nature-friendly farming techniques on our 320ha site. In recent years, much of our focus has been on soil health and productivity and how these may be able to contribute to national targets for ecosystem services



Dale drill at Allerton

and net zero.

As such, since 2017 we have been delighted to work alongside Syngenta on a long-term research project seeking to develop an understanding of a cereal cropping system based on Conservation Agriculture (CA) principles with the aim of promoting greater sustainability within the sector and making adoption of reduced intensity practices quicker and more reliable for growers and the wider industry.

CA rests on the following key, and widely appreciated, principles:

- Biological diversity (both within the rotation and the wider landscape)
- Retention of living roots in the soil through as much of the season as possible
- Maintaining soil cover to the greatest extent practical

- Reducing and optimising mechanical & chemical disturbance of the soil

This Syngenta-led pan-European project also involves NIAB in the UK and the European Conservation Agriculture Federation (ECAAF) on the Continent, among other partners.

The basic concept of the trial has been to compare the economic and environmental metrics of three contrasting tillage systems across minimum 1ha plots in a five-field, five-year rotation at the Allerton Project (a heavy silty clay loam site) and across a four-field rotation at a light-land farm at Lenham in Kent. These three systems are:

- Continuous inversion tillage (with subsequent secondary tillage)
- Minimum tillage (low disturbance sub soiling / disc-based cultivation)
- Direct drilling with no additional



Cover crop vs over winter plough

soil movement

The planned rotation at Allerton was winter barley, OSR, wheat, spring beans (with a cover crop) and back to winter wheat. (The reality of the climate in the previous five seasons has, however, led to some 'dynamic' decision making on the ground!)

At Allerton, we have utilised a Dale EcoDrill across all three systems, with a Vaderstad Carrier the prime implement in the minimum tillage system alongside a Sumo LDS where required. The ploughing was similarly worked down primarily with the Carrier, and occasionally a power harrow.

So, after five seasons, what did we discover across the rotation?

At Loddington, our crop establishment in the inversion vs DD plots has been reduced by 8%, reflected in a 7% drop in yield. However, big savings have been established in fuel use (44% down) and work rate (50% improved), while operational costs savings (11%) have been realised when reduced machinery, horsepower and depreciation requirements are taken into account. Thus, despite reduced gross output, net profitability in the DD system is 14% per hectare up on the inversion model. On the lighter land site in Kent, there has been no reduction in yield between systems, which has seen a resultant 16% increase in net profitability. The minimum cultivation regime sits solidly in the middle as a clear stepping-stone between the two.

On the environmental side, soil greenhouse gas emissions have seen



Dale drill at Lenham

an 8% reduction at Loddington (5% at Lenham) as a result of reduced soil organic matter oxidation in the DD system, while overall carbon footprint per tonne of production is down 4% (vs 9% at Lenham). In terms of soil structure, there has been a significant improvement (10%) in VESS scoring at Lenham, although we are yet to see any clear difference at Loddington on our heavy clay (following multiple very challenging years). However, our earthworm numbers are up by a respectable 13% (from an already very healthy level) whilst those at Lenham have improved by 112% over the five years, admittedly from a lower level engendered by the natural restrictions of their soil type.

Most dramatically perhaps, overwinter

bird counts on the respective trial plots have demonstrated a 247% higher level of farmland bird sightings on the DD areas versus the ploughed plots at Lenham – and a 2800% increase at Loddington! To give context, numbers of foraging birds – particularly lapwing – are negligible on the ploughed ground, whilst both reduced tillage regimes seem to offer a far more attractive habitat, with spilt seed from harvest, higher invertebrate numbers, and more cover.

Thus what we can demonstrate from the first five years of our Conservation Agriculture trial is that – solely by adapting establishment technique, whilst all other inputs remain the same – significant cost savings can be accrued in both time and money, while profitability can be simultaneously increased – to the benefit of the natural environment and climate.

Clearly, from an agricultural perspective this offers multiple benefits. Increased work rates allow growers to make better use of increasingly narrow weather windows, or to cover more ground as consolidation potentially gathers pace in the coming years. It also allows for reduced size and cost of machinery in a situation where land areas remain the same. The reduced 'carbon cost' of operations is also one strand in what will become an element of increasing focus for farm operations, that of reducing operational emissions for farm carbon accounting to service both national net zero strategies



Lenham plot cultivating vs plough plot

and that of the wider supply chain – as well as, potentially, farm carbon trading. With the increasingly volatile cost of fuel, a 50% reduction in its use is also a saving worth generating in its own right.

From an environmental perspective, the potential for DD-driven systems to contribute to an enhancement in the farmed environment is clearly advantageous, again as one element of wider integration of integrated farm management across the farmed area alongside measures such as participation in agri-environment schemes. It also aligns with some of the requirements of the developing Sustainable Farming Incentive (SFI) tier of the Environmental Land Management scheme (ELM).

What we have tried to achieve with the CA trial is to put to the test much of the anecdotal evidence cited by many growers who have set out on the journey to reduced tillage over recent years. In so doing, we have collected some 80,000 data points so far which can hopefully be utilised in a way



Gasmeter soil GHG analyser

which is more compelling than abstract conceptualisation. Bar charts and data tables might not stir the soul, but they can be the basis for a hard-nosed change in business practice! As such,

we certainly look forward to presenting this work at Groundswell this year on 28th June.

One point of note is that we have been conducting this work against an almost unprecedented backdrop of both financial and climatic volatility. On the challenging soils and steep slopes at Allerton, we have struggled to always establish crops in good conditions (or at all!) since 2018, with oilseed rape being a particular challenge due to the ongoing predations of cabbage stem flea beetle. The extreme market volatility arising from geopolitical upheavals in the past few years have also added an extra element of interest to the results: given the very high commodity prices available for harvest 2022 any loss of yield on the DD system was admittedly disadvantageous to the financial picture and did significantly reduce even more positive numbers achieved from the first four years. However, the financial picture must be taken over a full rotation, whilst from an environmental perspective ‘business as usual’ is no

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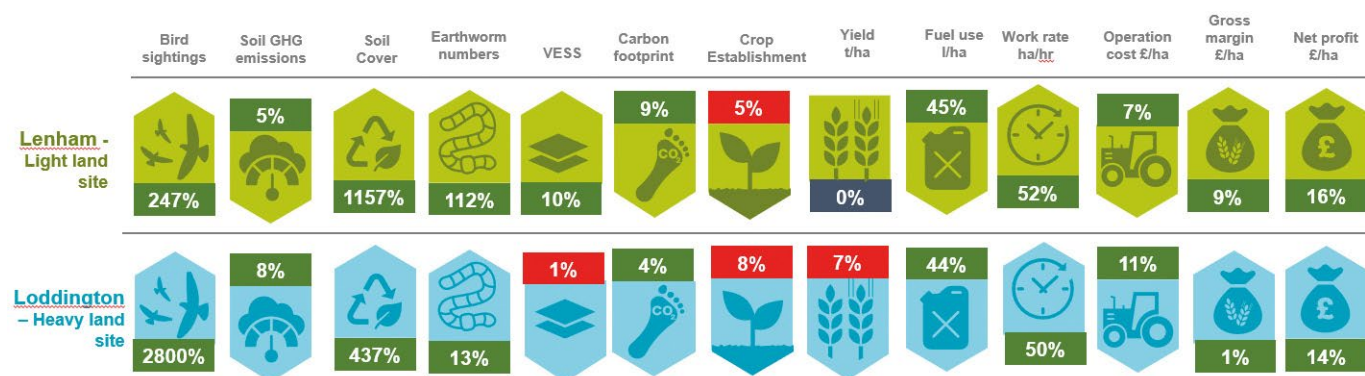
longer an option.

Going forward, we are pleased to be continuing this work with Syngenta as we progress to a second, more 'regenerative' phase over the coming years as we look to build on the solid data and foundations already built. Starting in autumn 2022, we have discontinued the 'min-till' plot in each of the fields, re-purposing it as a range of different 'regen' comparators to the main inversion/DD strips. In these areas, we will be assessing the impact of herbal leys, manure applications, the

potential to optimise synthetic nitrogen and the future role of biostimulants. We'll also be assessing how best to control problem grass weeds in a 'regen' rotation.

Our wider work at Allerton gives some clues as to what the future holds. Although we have yet to see significant benefits to a reduced tillage approach to soil structure or organic matter levels after five years in our CA trial, we are also conducting longer-term trials elsewhere at Loddington. After a decade under CA principles, other arable

land has registered a 10% increase in soil organic matter and significant improvements in soil structure, worm numbers and soil microbial activity. Five years is in reality a short period of time when it comes to building soil health and carbon (especially in the absence of significant organic manure inputs). We hope to have laid the foundations of what should be an exciting second phase to the project, where we can perhaps do a small part to redefine what it is to be a 'good' farmer in the 21st century.



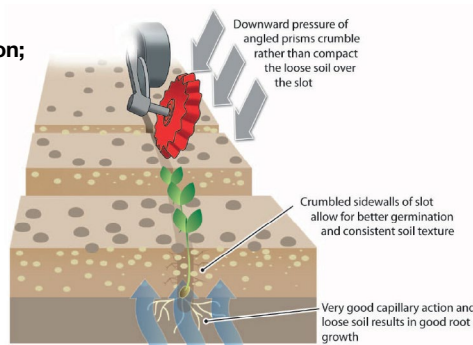
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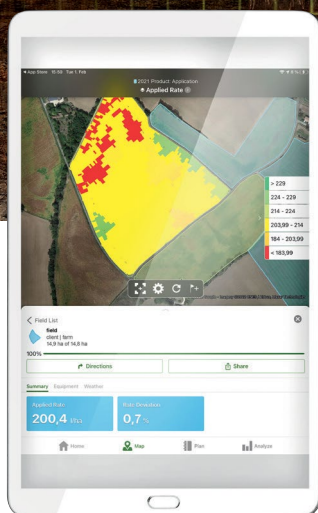


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HIGH SILT CONTENT SOILS MAKE FOR A **SLOW DRILLING** TRANSITION

After five years of cover crops and reduced tillage cultivations, Kent farm manager Dom Hughes reviews his experience – and how good advice has been vital to not making a mess of it.

“Slowly, slowly catchee monkey” has become my mantra. This old English proverb, which is another way of saying ‘be patient’, is perhaps the most apt way of describing the transition to a less intensive cultivation regime. It also helps to inject a modicum of humour to a process that has at times being both stressful and frustrating.

Across 800 hectares of sandy loam over chalk in north Kent and silty and clay loams in East Sussex, M. C. Atwood & Partners follows a rotation of combinable crops that is typical of the lowland England. In most seasons this is winter wheat – winter wheat/spring barley – winter barley – winter oilseed rape/winter beans/spring linseed.

The intention is to have roughly half the farm in winter wheat as this is consistently the most profitable cash crop. None of the break crops are especially impressive, but with the alternatives even less worthwhile, we persevere.

My focus over the past five years has been to maintain output performance while simultaneously preparing the business for the withdrawal of direct payments and the introduction of a system geared towards environmental actions.

Until 2018 a Simba Solo performed most of the cultivations with some land ploughed. Crops were then sown using a Vaderstad Rapid drill. This regime worked well, but there was a recognition that it was not sustainable. The policies emerging from Defra at the time (and since) favoured a less intensive approach and within the business there was the view that our spend on crop establishment was too high.

Around the same time we took on a new agronomist in Neil Harper of

Agrii. Neil has been central to our efforts to develop a new system. His understanding of the farm and the reasoning that is guiding our decisions has helped to ensure we make good progress. He also appreciates that this is not some form of pseudo religion that puts philosophy above profitability.

Under the Ecological Focus Areas introduced as part of the greening measures, we began to experiment with cover crops. We noticed that in some situations this made the soil easier to work. This spurred our interest and through regular inspection digs to monitor changes, several visits to Agrii’s research farm at Stow Longa and follow-up discussions with Steve Corbett, Agrii trials manager, we began to take a more serious interest. We were made aware, however, that it is not all rainbows and unicorns; it can take many years to see

the benefits, especially financially. This was sage advice and we have found our way both slowly and cautiously hence the idiom at the start of this article. Cover crops now form part of the rotation and are established in the autumn ahead of the spring barley. In some years this can be as much as 20% of the farmed area.

In the years since 2018 we have sold the Simba Solo and bought a less aggressive disc cultivator that wears less metal and requires less diesel to pull. The Vaderstad Rapid has been replaced by an Amazone Cayena.

Silt is the main component in most lowland mineral soils and it is the reason why our endeavours with direct drilling have yielded mixed results. It naturally settles out to form a solid layer that roots can’t penetrate. During periods of dry weather when crops can’t access



Kent drill demo day 1

moisture the consequence of this are clear for all to see. We've direct-drilled oilseed rape and some winter beans with success but found that it doesn't suit linseed. There are some cost savings, but they are minor in the grand scheme. When the reduction in output eclipses the savings in costs, it's time to ask the obvious questions. This was the situation we found ourselves in after direct-drilling wheat into linseed stubble. It drilled fantastically but yielded 1t/ha less than that sown into cultivated ground.

In contrast, we have found that drilling into a cover crop results in better performance [than sowing into stubble]. There are, of course, other considerations. Less surface run off into ditches or out of gateways are non-cash benefits, but as an employed farm manager, my first responsibility is to maximise profitability, albeit within the framework of good environmental practice.

This harvest we will trial a short season cover crop consisting of a legume mix for the eight to 10 weeks between harvest and autumn drilling. We will see how it goes, but it must not jeopardise the autumn drilling window. We have a 10-14-day window in October when we need to complete our autumn drilling; if we are not drilled up by late October, yields suffer.

Cover crops versus metal

My interest in cover crops extends to their soil conditioning properties. I am not so naïve to think they can replace metal, but there must be a happy middle ground. Based on what I and Neill have observed so far, a



Kent drill demo day 2



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cover crop mix of phacelia, vetch, buck wheat and linseed looks to be the best for our situation. As for low disturbance sub-soiler cultivators, I'm leaning towards the He-Va Stealth from Opico.

I've also sought to recoup the cost of the seed by renting out the cover crop for winter grazing. I accept that sheep can have a place on an arable farm, but it is not an experience I wish to repeat. We found that they tread the ground a little too much, especially when it's wet. This removed much of the soil conditioning benefits of the roots. We ran a split field comparison and after comparing establishment performance and scrutinising the costs to allow for different N Min values, the cover crop without sheep was the most viable option.

I've tried to be more analytical rather than anecdotal in my assessments. I've compared the soil analysis results from pre- and post-cover crop regimes; I've considered soil health indicators such as worm numbers and whether yields have shown less variation. On all points there are signs of encouragement, but it will take a few more years to confirm we are on the right path.

A second drill

We have come to recognise that having a second drill would be to our benefit, but

it needs to be economically justifiable and not just the 'nice-to-have' second machine for when we are up against it. This served as the motivation to host a demonstration day and it is to Agrii's credit that it managed to arrange for 17 drills from 13 manufacturers to attend. More than 200 farmers attended the day. It was therefore a shame that the wettest March for more than 40 years meant conditions on the day were so poor that no drilling took place. Fortunately, eight of the manufacturers agreed to leave the machines with us for a week and once conditions improved, we got to work.

There is also the dreaded issue of black-grass. Our use of residual herbicides is now far more targeted than it was while the change in cultivation policy of recent years has done much to reduce the area to be sprayed with Pacifica Plus (amidosulfuron + iodosulfuron-methyl-sodium + mesosulfuron-methyl) but the bank of dormant black-grass seed is considerable. This needs to be remembered when looking at drill design and configuration.

So which drill do I think will best suit our situation? At the moment there is little to separate them. In my opinion the Amazone Cayena was the best all-round machine – if only it was wider than 6 metres.

The Amazone Condor appealed

because it followed the contours well, but I was disappointed with the soil closing behind the coulter. I was impressed with the John Deere 750A, but the conditions suited a disc drill. How do we recreate the mineralised nitrogen we get with a tine if we move to a disc drill? I don't know.

I was also pleasantly surprised by the Kuhn Espro which has done what looks like a nice job albeit it has moved a lot of soil and we may yet see a flush of black-grass which we don't have the means to control other than with glyphosate or by rogueing.

We arranged for a neighbour to come in with his Horsch Sprinter, but with Dutch openers it was a little different to the demo machine and also moved a lot of soil. The Simtech machine was a surprisingly easy drill to set up and has done a good job. It's a simple machine with not too much to go wrong so I can see its appeal. This is where drill configuration becomes important to performance. There are different types of point, opener, closer and packer designs. Then there are front packers, leading discs and spreader plates to consider. It's a minefield of considerations.

What is apparent, however, is how drill design and configuration has evolved. Choice largely comes down to how much cultivation you want? It's not an exact science and we need to better understand the nuances of each system and the trade-offs that exist between different designs, before we can answer the question.

Nor should we fall into the trap of seeing transformations in performance as the result of one single management change. There are other factors to consider, not least the weather and the inevitable need to address compaction. There are certain practices we need to observe too, such as the need to incorporate sewage sludge, farm-yard manure and other organic soil amendments. It would be easy to think of direct drilling as the nirvana of systems, but in my experience, it's about achieving a balance. For us this means a sub-soiler cultivator of some description though I accept a return to the Simba Solo is perhaps a little extreme.



Kent drill demo day



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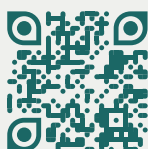
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CULTIVATION WILL IMPROVE YOUR **SOIL STRUCTURE**

Written by James Warne from Soil First Farming

Many years of looking at soil proves to me that cultivations never improve soil structure. They may help to overcome an immediate problem – like compaction. But they are only ever a short-term fix; and not a very good one, either.

Cultivations always leave some sort of pan. Either a mechanical pan from smearing or trafficking. Or a sedimentation pan where the act of moving the soil puts the surface crumb beneath lumps from the previous year's pan. It may not be immediately obvious but it's always there. And it will always build to bite you back. Subsoiling is sometimes necessary to deal with structural damage – most often from previous soil working under the wrong conditions. But rotational subsoiling as a matter of course – regardless of whether or not it's needed or where – is nonsensical. It becomes habit, once you start doing it you need to do it more to achieve the same result. Subsoiling eventually results in a soil that packs down tighter than it was before the subsoiling took place. So it completely defeats me why so many of us who want to achieve exactly the opposite – quite often with some fairly poorly-structured soils – continually turn to metal at depth. Maybe it's not only our soils that are addicted?

As well as hugely damaging to long-term soil structure, deep cultivation, is the enemy of organic matter. Every time we introduce air into the soil it oxidises carbon from our precious OM bank. The more air we inject the more carbon we lose. As if that's not enough, cultivating soil decimates the worm populations. The deep burrowing worms which provide channels for drainage and air-aeration. It also disrupts the natural sub-soiling action of previous crop roots that provide preferred pathways for new root penetration & drainage for rainfall. Also not forgetting all the other important soil biology such as fungi & bacteria. Fungi, in particular, do not like being disturbed. If you are on a regenerative path and still insisting on doing some cultivation the soil biota are never going to be in a position to provide the ecosystem services you are searching for, drainage; aeration; fertility; carbon sequestration; crop health and most importantly for you, output. All of these will be compromised with the

introduction of steel.

Whilst on the subject of cultivation I notice that there is a move towards light cultivation in front of spring cropping in the belief that this improves yield. The question I ask is what does the cultivation bring that increases output? Answer, it's releasing fertility. Part of a cover crop's function is to cycle nutrient and prevent the loss of mobile nitrogen. Unfortunately this fertility will be not be instantly released to the following crop, therefore to overcome this we need to be more considered with our fertiliser applications in the spring to ensure that we do not restrict the nutrition to the following crop. Cultivation works against everything that makes the greatest natural contribution to soil structuring – organic matter, earthworms and old root runs. And the sheer amount of horsepower, and the weight of the machine to transfer the horsepower needed doesn't do most soils any favours either.

So, the most sustainable way of improving soil structure is less, not more, where tillage is concerned. We need to allow the sort of carbon-fuelled biology we see under permanent pastures to work its magic; not least letting the glomalin and vast array of other organic compounds produced by soil flora and fauna develop the tilth and stable soil particles we need without continual disruption and disturbance. Our preference is for cultivating only the relatively small amount of ground around the seed as part of a no-till (do not confuse with strip till) approach. This gives us the best of all possible worlds. We achieve a nice tilth where the seed really needs it for germination and establishment while maintaining the best, undisturbed soil structure everywhere else.

We get rapid and effective root proliferation to depth, just the right



The difference a cover crop can make to soil quality, soil dug from the same field a few years apart, left no cover crop, right cover crop.

conditions for nutrient and water uptake and the least crop vulnerability to drought or flood. We also get ground with a greater ability to tolerate traffic, fewer weed problems, lower cultivation costs and higher establishment work rates.

Of course, this sort of natural structural improvement doesn't offer the quick fix of sub-soiling. It can take many years of determined action to bring a soil round and overcome the problems created by over-cultivation. This is where the choice of system is of paramount importance; rotation; diversity; cover crop.

Equally, we can't just move into direct drilling overnight and expect everything to improve. Choosing the right point in the rotation to make the switch is a useful consideration. Looking at crop performance should also give an indication of the soil functionality. While we are doing this we need to accept that we're in a transition that may mean we have to accept some short-term pain for the long-term gain we're after. Not only this, but we should also reconsider a number of other things we always done – like incorporating straw, grass in the rotation, muck, etc.

Appreciating the complex physical, chemical and biological characteristics of our greatest asset – the soil – and working with it to make the most of them is a better way forward than continually trying to rely on cold hard steel and plenty of horsepower. This will never give us the sustainable soil structure we need.

So, as we move towards cultivation season once again ask yourself which cultivations are really necessary? Could a cover crop do the work for you? What cover crop species could offer the best investment?

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COMPANION CROPPING IN OSR APPEARS TO REDUCE HERBICIDE LOSSES TO WATER



Affinity Water has been working with local farmer, Rob Fox, to investigate the role of companion cropping on improving water quality, soil health and crop protection. Direct Driller, delves into what they've found from the ongoing trials.

Catchment areas in the UK are largely dominated by agricultural land, which makes collaboration between water companies like Affinity Water and farmers essential to protecting essential natural resources – water and soil.

Cover crops play an important role in building soil health and are a key part of Affinity Water's strategy to help make catchments more resilient to the weather extremes experienced in recent years, reduce soil erosion and fix excess nitrate in soils which can potentially impact groundwater quality.

The Affinity Water catchment team has been working with farmers in their catchments to fund cover crops and so far, have funded over 3700 hectares since 2020.

To take this further, the company has been trialling the use of companion crops with home counties based farmer, Rob Fox.

Companion cropping trials

Rob Fox, farm manager at Woodhall estate in Hertfordshire, has been working with Affinity Water and Alan Dewar at Dewar Crop Protection to look at how companion cropping in oilseed rape (OSR) could protect nearby watercourses from herbicides losses and help benefit crop production.

The first trial in 2021/22 focused on sections of an OSR field, where selected companion crops, buckwheat, fenugreek and berseem clover were planted in with the OSR and compared against a control area of just OSR.

The results from the first trial showed benefits for water and the crop also experienced less flea beetle damage in the OSR which had companions compared to area with no companion crops planted.



OSR Field

"It was clear from these results that companion cropping was delivering for the crop as well as the watercourses," says Mr Fox.

A year on, they have carried out a replicated trial to measure the true impact of companion cropping on a larger scale.

"This year we're carrying out a replicated trial in OSR that's under-sown with both berseem clover and buckwheat. The trial spans 23 tramlines across a 30-hectare area, along with a control area which has no companion crops planted," he says.

"Having such a large area of replicated trials allows us to make meaningful comparisons, including with crops that have had no companion crop planted," he says.

Mr Fox explains that flea beetle control and the promotion of soil health are most important from the farm business perspective.

He says: "From the farm's point of view, we're trying to reduce the flea beetle burden on OSR at establishment, improve soil health and promote more sustainable pesticide use to protect nearby watercourses."

"We're already seeing some promising results from the ongoing trials, especially when it comes to flea beetle damage. When comparing the two areas it's clear that there is much less damage in the companion cropping area," he says.

Dewar Crop Protection carried out cabbage stem flea beetle assessments which showed the positive effect of the companion cropped plots of OSR. More of these trial results will be revealed at Groundswell in June. Growers are encouraged to visit the Affinity Water stand to learn more.

The benefits for soil and water

Danny Coffey, agricultural advisor at Affinity Water, explains that companion cropping in OSR could have huge benefits that farmers can reap, not only for water quality but soil and crop health.

"Firstly, companion crops in OSR such as berseem clover appear to reduce soil water concentrations of herbicides, such as propyzamide, due to additional vegetative cover they provide over winter," he says.

"While growing, the additional protection companion crops provide, may help reduce herbicides being lost from fields and protect the environment and water supplies. r. The trials run at Mr Fox's farm have been very interesting and really helpful for us as we develop the funding on offer to farmers in target catchments".

"Companion crops also have the potential to help improve



Danny Coffey, agricultural advisor at Affinity Water

soil health. Once they're incorporated into the soil that is additional organic matter which is added and if a legume, such as clover, has been used – like in this trial – their nitrogen-fixing characteristics serve to increase soil fertility.”

“The results so far have been really encouraging and we have learnt a lot from working with the Woodhall Estate about the practicalities of companion cropping and how we can best support farmers.”

Longer term, Affinity Water will continue to work with the farming community who are helping to improve soil health across catchments, protect water quality and the safeguard

the environment, as well as produce food for the nation.

“There’s a lot of interest in the results of these companion cropping trials so far and we look forward to sharing them with farmers at this year’s Groundswell,” he says.

Affinity Water at Groundswell

Affinity Water is the largest ‘water only’ company in the UK, serving over 3.8 million people in the south-east of England.

Affinity Water will, once again, be the headline sponsor of Groundswell, demonstrating healthy soils, cleaner water and a sustainable future can all be delivered on-farm, by showcasing the results from their recent companion and cover cropping trials .

Companion cropping is one of the initiatives Affinity Water’s catchment team has been supporting farmers in their catchments to implement to help reduce losses of the herbicides such as propyzamide to watercourses, rather than relying on expensive end of pipe treatment solutions.

Mr Coffey adds: “Groundswell allows us to learn more about regenerative agriculture, highlight the journeys which many farmers are on to improve their soil health.

“Healthy soils buffer extreme weather events, the water that falls onto soils rich in organic matter is filtered as it drains into water courses and infiltrates down into aquifers – soil and water are intrinsically linked and well-functioning

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soils across catchments, is the most sustainable form of water treatment there is.

"There are so many pressures on farmers today to not only make land management decisions which sustainably produce our food, but expectations to enhance biodiversity, sequester carbon and protect our water.

"As a water company, we benefit from this way of farming across our supply area, the insight farmers share with us and it is only right that we support farmers in this journey."

Delegates are encouraged to come along to the stand to talk to the Affinity Water catchment team about their catchment management schemes and ongoing trial results.

Affinity Water at Groundswell

- Stand FY1: Affinity Water Catchment Hub
- Rainfall simulator video – at the Affinity Water Catchment Hub
- Free souvenir Groundswell re-usable water bottles
- Catchment hub area representatives include; Herts & Middlesex Wildlife Trust, University of Reading, Cranfield University and Affinity Water's biodiversity team.



OSR Field

Farm Facts:

Woodhall Estate, Hertford, England

- Farming: 3,500 ha mixed farm, with 2,000ha arable crops
- Primarily producing wheat as well as barley, oilseed rape (OSR), oats and beans.
- Over 9% of farm is in stewardship

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“Mike, I hope you and the team are doing well. Thank you for your fantastic work in getting out this essential publication. *Karl Broderick*

“Looking forward to another issue. Great magazine thanks for all the effort in putting it together. *Mark McCaughtley*

“I really do believe that reading your editorials and financial pages has hugely contributed to our success. Best of luck – you can always call in if you are about anytime. *Adrian Marsh*

“Mike and team - congrats and thanks for all the useful and interesting reading through the years - a good job well done... many, many thanks' says *Greg McGovern from Co Cavan*

“Keep up the good work. PFI is the only farm mag out of about six we get that I read every word, cover to cover. Excellent" wrote *Mr Knight of Minehead, Som.*

“I find your magazine excellent with some terrific ideas, many of which I have used and/or adapted over these past few years. Keep up the good work. *Best regards John Gilgunn*

Hi all

It's encouraging to get these kind words, and yes, Practical Farm Ideas will continue to publish material that helps all readers. Of course we are always looking for those fantastic problem solvers, so, any help in unearthing them is much appreciated!

Mike Donovan

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THE FUTURE OF EFFICIENT CROP ESTABLISHMENT

THE REGEN/ORGANIC CONUNDRUM FROM A FARMER'S VIEWPOINT.

Written by Wilfred Mole, Lower Pertwood Farm, Wiltshire.

The debate continues between arable farmers worldwide who feel that they should remain conventional, in the traditional sense, and a growing number of farmers who are convinced that Regenerative ("Regen") is the way forward. The small Organic arable sector is also questioning their role, due to the fact that "Regenerative" in principle has the same objectives, i.e., to be much kinder to one's Soil and to farm with Nature where possible.

The sound principles of Regen farming resonate very strongly with most farmers for two reasons:

- 1) They realise that something needs to be done urgently to mitigate the negative implications of climate change as they are directly affected.
- 2) They also realise that the farming practices of the past utilized overzealous ground engagement practices which can now be reversed.

A change in the climate itself has created different farming conditions. While ice melts at the poles and deserts spread nearest the equator, the UK has largely benefitted from prevailing weather conditions. One only has to travel around the English countryside to see how robust the pastures appear to be and how well everything is growing, particularly in undisturbed wilding areas where no one is actually interfering with the process.

As arable farmers, our unofficial guideline to Regenerative practices is as follows:

- 1) Don't disturb the soil.
- 2) Keep the soil surface covered.
- 3) Keep living roots in the soil.
- 4) Grow a diverse range of crops.



Gerwyn Hughes (left) and Dan Davies ready to drill.

- 5) Bring grazing animals back to the land.

Central to these priorities is soil. Everything we do on the land affects the soil and a farmer who has the best interests of his soils at heart will prioritize this issue and place it at the center of the farms' ongoing arable strategy.

This is where the Organic / Regenerative conundrum emerges. Unfortunately, a fundamental and often unavoidable practice in organic arable farming is to plough. It has



Wet Field North after topping.



been that way for over 150 years with both animal drawn and manual soil disturbance being practiced for centuries. It continues to be the primary method used by Organic arable farmers to control weeds. In so doing, it flies directly in the face of one of the most important aspects of the Regenerative farming model. Any farmer wanting to improve soil health would not want to plough, and added to this the dramatic increase in diesel prices and the wear and tear on the machinery has made ploughing a costly exercise.

Having an organic farm in the Southwest of England provides us with an opportunity to understand what it

is like to produce organic crops against the background of the regulations that govern the organic sector. We also acquired a neighboring farm a few years ago that was conventional, and we decided to leave it that way because it provided us with an opportunity to experiment outside of the Organic regulations. In short, it is our Regenerative farming laboratory.

Having been Organic since 1987 we are in a unique position to understand how Organic works because we have followed the rules for decades. Much of what we do in the organic arable sense is already regenerative. The absence of any form of artificial fertilizer,

pesticides, weed killers, glyphosate etc. is the bedrock of the organic system and has resulted in an array of ecological improvements and has allowed the farm to recover its vitality over the years. We have not had many practical solutions to the challenges we face in an Organic arable environment.

However, by taking a leaf out of the regenerative book, we are beginning to find ways of adapting to the challenges that exist, some of which often happen incidentally. The heavy rains of the last few months meant that our arable programme was delayed. One particular 120 acre ley was still untouched at the end of April. It has been in grass and



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It has been a busy year since the Conference in February. We had a fascinating webinar with Frederik Larson from Denmark on companion cropping including using Lucerne sown under wheat. We hope to have a members visit to Denmark later in the year. A visit to Rothamsted Research to find out more about their EcoStack project and carabid beetles; a visit to Wildfarmed where Andy Cato presented his vision and hosted a tour of Colleymore Farm.

John Pawsey and Edwin Taylor hosted farm walks and Tom Storr followed up his Conference presentation with a visit to Dyson Farms Nocton site. There are still plenty of opportunities to meet up with us. We will be attending Cereals (stand number 609) and Groundswell Festival (stand number PFE3 near the Earthworm Arms).

We also have a member's farm walk at Raby Estates on 12th June (thanks to Philip Vickers) and a visit to the Lamport Project on 3rd July (thanks to Niall Atkinson and Agrovista). There are also plans to visit Frederic Thomas in the Autumn.

In an effort to further the skills of members wishing to pass on their knowledge, the committee decided to offer members the opportunity to apply for a public speaking/presentation course which will take place in September at The Farm Education Centre with Susie Emmett from Green Shoots Productions undertaking the training. 16 members have taken up this fantastic offer and we look forward to hearing from them in the future.

The committee also decided to create a new membership group for anyone under the age of 25 years who is not in full-time education for just £20 + VAT/year

If you would like to know more about how to join BASE-UK, please visit our website: www.base-uk.co.uk or email Rebecca@base-uk.co.uk

clover for a number of years and was in a very good state to be converted back into a fertile arable field. However, for that to happen, in theory it had to be ploughed.

We estimated it would take 5 days to plough it, but conditions were too wet to drill an arable crop before the end of May. Our team, supported by our agronomist, responded proactively to the challenge and came up with an innovative idea. They suggested we top it, leaving the organic material on the surface. Then, using our Horsch Avatar planter, we were able in one non-stop session to direct drill Organic own grown barley in 16cm rows directly into the topped grass/clover ley.

Some disturbance of the soil remains appropriate in some circumstances unfortunately if crops are to be grown. If ploughing is necessary then it should be shallow (5 inches or less). There are many advantages to be gained from minimising tillage and keeping "trash" on the surface, all the while encouraging soil flora to develop their capacity to incorporate organic matter as much as possible.



Warm weather encouraged germination and now after 2 weeks the race is on.

Glyphosate which is a potential tool of Regen is a useful and beguiling tool but it is also a carcinogen, and counterproductive because it kills the very bugs that one is trying to encourage. Likewise, soluble fertilisers. In addition a core issue with regards to sustainability is the carbon/nitrogen balance. If one wishes to increase carbon in the soil, then this tends to lock up the nitrogen.

A Regenerative Farmer up to now is not governed by any regulatory body nor priced at a set premium. Regen is a concept encompassed by a word and there are no rules, no precise definition, no legal framework, no regulatory structure, no clear point of difference and no established market.

Thus, the practices that are being adopted are left entirely at the farmer's discretion. They have their conscience and the best interests of their soil to motivate them going forward. The Organic Farmer on the other hand, if ploughing can be avoided as per the example above, may achieve an excellent income per Ha due to low input costs with reasonable yields and an a significant price premium.

The Organic sector receives a premium on organic products because they are correctly perceived by the marketplace to have been produced in a healthier way than similar products from conventional farms. However, there is growing awareness of the



benefits of Regenerative farming to our soils and potentially to consumers. This is beginning to be recognised by industry, as demonstrated by the example of Carlsberg Breweries who are now insisting that Malting Barley for their major breweries across Europe are grown within a Regenerative system. A comment by one of the farmers interviewed said "Carlsberg are actively rewarding those farmers who use these techniques." We may be seeing the dawn of a new premium to reward Regenerative farmers in much the same way as Organic farmers are being rewarded.

Overall, we believe that Regen is at the moment a mid way station, a halfway house on the path to "regenerative organic" promoted as the holy grail by respected organizations like The Rodale Institute in the US. Regen as it stands is still immature and undeveloped as a food production system. The principles of Regen and Organic are certainly aligned. However we cannot see Regen replicating the Organic model by introducing all the bureaucracy and auditing that Organic farmers are subjected to.

Realistically, a farmer can be Regenerative without converting fully to organic, and that makes it easier to get going. In our case, if our experiment succeeds, we have removed a major cost factor in terms of land preparation by not having to plough, and it also relieves us of a moral burden because we are convinced that disturbing the soil by ploughing is an unacceptable practice.

What is obvious is the fact that more and more farmers are recognising that if they think outside the box, and if they have confidence that it might have a good outcome, then they must take risks and go for it. We could also ask the question as to why mainstream agriculture of our and our parents' generation did not do more to move in a Regenerative direction earlier. The fact is that the technology did not exist for them to do what we can do today and they simply farmed with the tools and knowledge they had. In the modern world, one can now do things differently, but it requires a bold approach by the Regen-minded farmer who is in many cases still operating in uncharted territory.



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THE TRANSFORMATIVE POWER OF SOIL CARBON: A CASE STUDY WITH AGRICARBON

Written by Harry Kamilaris

Soil carbon has emerged as a transformative force in agriculture, offering a solution to combat climate change while improving soil health and productivity. Agricarbon is at the forefront of soil carbon measurement, providing farmers with an accurate and easy-to-use service to measure and monitor their soil carbon stocks at scale. In this article, we will explore the significance of soil carbon, Agricarbon's approach, and a compelling case study showcasing the impact of their work.

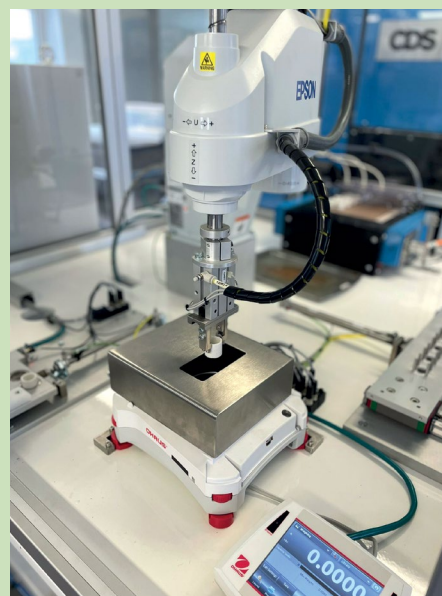
Increasing the amount of carbon in the soil plays a pivotal role in enhancing overall soil health, boosting agricultural productivity, and sequestering carbon dioxide from the atmosphere. The benefits extend beyond improved soil structure, nutrient cycling, and water retention. They also include supporting

thriving microbial activity and fostering biological diversity, which contribute to positive environmental impacts and bolster farm economics.

Soil carbon is a leading indicator of soil health, and regenerative farming practices can help increase soil carbon stocks. Small increases of Soil Organic Carbon over very large areas in agricultural land will significantly reduce atmospheric carbon dioxide. Some studies suggest that for every 0.1% increase in soil organic matter per hectare, nine tonnes of CO₂ could be removed through sequestration. Additionally, it is suggested that the same increase in soil organic matter allows the soil to hold an extra 28,000 litres of water per hectare, reducing



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Co-Founders Stewart Arbuckle and Dr Helaina Black reviewing soil at Heathrow

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First Milk, a pioneering dairy cooperative, quickly recognized the long-term value of baselining a significant portion of their farms. They chose to partner with Agricarbon to ensure integrity along their sustainability journey. Agricarbon conducted comprehensive soil carbon



Extracted Soil Core Showing Stones v3

sampling and analysis, baselining soil carbon stocks across various landscapes and management practices. Supported with this information, First Milk has implemented strategies that target enhanced soil health and increased carbon sequestration through regenerative farming techniques.

Mark Brooking, Sustainability Director at First Milk, explained, "We've committed to sequestering an additional 100,000t of CO₂-e in soil each year by 2025. To prove we are achieving this, it is important that we establish the baseline position, and then continue sampling in the future to demonstrate the change that's been delivered via our regenerative actions."

Through their collaboration with Agricarbon, First Milk successfully leverages accurate soil carbon data to drive their sustainability initiatives. The partnership allows them to monitor and measure their progress, providing a robust foundation for their sustainability goals. By embracing data-driven practices and showcasing the positive impact of sustainable farming, First Milk has positioned themselves as pioneers in the dairy industry. The case study of First Milk exemplifies the transformative power of accurate soil carbon data.

In short, farmers like you will always make the difference, and Agricarbon measures it.

To learn more about the benefits of measuring and increasing your soil carbon, reach out to one of Agricarbon's friendly team members. We will also be exhibiting at Groundswell this June, where we welcome any questions that you may have.

Alternatively, you can contact me directly at

hkamaris@agricarbon.co.uk.

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AGRONOMIST IN FOCUS...



TESTING SEASON HIGHLIGHTS THE NEED FOR WELL MANAGED CULTURAL CONTROLS

by Chris Martin from Agrovista



If ever there was a year to highlight the need for flexibility and the adoption of as many cultural controls as possible to manage weeds and diseases in winter wheat crops, this is it!

The relatively mild and dry early winter led to comparatively forward stands in February. This was followed by an excessively wet spring, combined with cool, damp and often waterlogged soils and lack of sunshine until the second half of May. Little wonder that crop management has been particularly challenging.

Hopefully the weather took a turn for the better just in time for most crops to perform well. But it has been a real challenge all season for growers and agronomists alike to try to maximise this potential.

When put under extreme pressure, often linked to early drilling, even the most robust synthetic herbicide and fungicide programmes have struggled to cope. Grassweeds are now poking out of the top of many fields and *Septoria tritici* lesions can be easily found throughout the crop canopy.

Years like this really highlight the golden rules for successful direct drilling, namely maintaining good drainage and a flexible diverse rotation. In some fields you can clearly see that crops are significantly greener and taller over the drains than in the rest of the field.

It must be remembered that drainage starts from the soil surface downwards. Following the recent extreme weather, many natural drainage channels have been impeded and will need attention before the next crop.

There is a saying that 'you get the weeds you deserve', and again this couldn't be truer than this season. Just like with herbicides, weeds will become resistant to our cultivation strategies if we continue to do the same thing every year.

With the open autumn last year and promising commodity prices at the time, it was tempting for some growers to try to direct drill a second winter cereal crop and, in some

cases, even a third, putting in winter barley after two winter wheats. However, the dry autumn and keenness to establish crops early following the experience of recent wet autumns meant stale seedbeds were not particularly effective. Sterile brome in particular has thrived in these situations.

Testing the fungi:bacteria ratio in soils is a useful tool to at least create a welcoming environment for arable crops. Earlier succession plants such as bromes and blackgrass tend to prefer bacteria- and nitrate-dominated soils, with a fungi:bacteria ratio circa 0.3:1.

Such environments are often created by traditional industrial farming, with intensive cultivations destroying fungi and nitrate fertilisers encouraging bacterial blooms. In other words, through industrial farming, we have created the ideal environment for some of our biggest enemies.

The arable crops we are trying to grow prefer a more even fungi:bacteria ratio, for example 0.7-1:1, and more ammonium. Whilst this can't be changed overnight, comprehensive soil testing can provide a useful indicator as to where soils are today, to help growers make informed management decisions, accelerating the journey to regenerative agriculture.

Some of the key tools to improve beneficial soil fungi levels include some of the following: reducing cultivation intensity, lessening reliance on nitrate-based fertilisers, chopping straw, adding compost, applying mycorrhizal fungi, particularly after non-mycorrhizal-associated crops such as brassicas, and using specific fungal feed such as humic and fulvic acids.

Disease control has also been an issue this season. Later-drilled crops and variety blends are noticeably cleaner, but



even these are dirtier than we would like when sown early. There are lots of mixed reports with growers trying various biological compost tea-type products, with some claiming good results.

However, in most crops that have been under unprecedented Septoria pressure throughout April and early May, growers have resigned themselves to applying robust rates of the best synthetic chemistry such as fenpicoxamid or mefentrifluconazole for reliable disease control.

When using such synthetic fungicides it is very important to consider application technique and nozzle choice, ensuring as much of the herbicide hits its target and as little hits the ground as possible, thereby minimising collateral damage.

"Years like this really highlight the golden rules for successful direct drilling"

This becomes increasingly important with wider coulter spaces often found with larger direct drills. As a general rule, more chemical tends to penetrate through the crop canopy and hit the soil when using a coarser spray droplet, which many of us now use as standard to minimise drift.

Crop nutrition has been another area which has been difficult to get right this season. The excessively wet early spring increased the risk of leaching of several nutrients, including nitrates and sulphates. In addition, the lack of application opportunities and the wet, cold, often anaerobic soils reduced soil biological activity, which slowed recycling rates of nutrients in the soil.

As a result, many crops have been hungry at some point during the season. Regular sap testing or growth-stage-related tissue sampling once again have proved their worth, highlighting key deficiencies and enabling timely correction.

Heavy rain in the early spring can cause significant soil damage, so the number one priority before establishing



next season's crop is to go out with a spade to identify and correct any soil issues. Where cover crops are being used, deeper-rooting species such as tillage radish or berseem clover could be considered in these situations to help restructure soil.

Cover crops can also be used as a tool to identify areas where nature may need a little help. Areas where plants are struggling to cope with compaction will become apparent, and can be targeted with a low-disturbance loosener while the cover crop is in place.

This will help 'release' the roots and restructure the soil without the expense and damage to natural soil structure from having to cultivate the whole field.

** Agrovista's Regenerative Agriculture Guide is available at www.agrovista.co.uk/agrovista-downloads. Other Agrovista guides including Cover Crops Guide 2021, Soil Health Guide 2020 and Guide to Cultivations and Drills for Combinable Cropping are also available to help growers explore sustainable farming principles.*

Groundswell provides a great opportunity to explore the techniques outlined in this article, where you can hear about the theory and investigate the practical applications to improve your soil health and the resilience of your farming system.

Above all, choosing the right partner who can deliver the right advice based on sound knowledge and experience is a great first step to take. We at Agrovista are here to help you succeed.

Whether you are mildly curious or have already embarked on the journey, please do come along to our stand at Groundswell for a friendly chat and to see whether we can help you make the right choices to deliver your goals.

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FARMER FOCUS

TOM SEWELL



Well, it's always interesting sitting down to write an article and thinking of things to wax lyrical about. Quite often, the farmer contributions are all about success stories! Like how to grow 12 tons per hectare of 13% milling wheat on 20 kilos of N and an application of home-brewed compost tea, how a 15-way multi-species cover crop can save the planet, or the latest piece of life-changing machinery that will transform your business! Of course, I'm slightly exaggerating, but I do find myself continually searching for positive things to say every six months!

So, given that not everything is rosy all of the time, this update will be more glass-half-empty than full! There is a saying that goes along the lines of "two steps forward and one step back," and this year seems like the "one step"!

Before I delve into that remark, it's important to give some background to my claims. 2022 was actually a great year for our business. Crops grew remarkably well in very dry and hot conditions. Harvest was very easy, with every ton harvested dry, and yields were pleasing with very high bushel weights. To top it off, wheat prices were at record levels, and although I missed the highest prices, I did sell a fair chunk above £300 per ton. However, the last load to clear the shed this month was only sold at £200 per ton. So financially, the harvest has been a success. We have also managed a major clear-out of surplus machinery, including a 3m power harrow drill which first made an appearance on the farm in 1985! This has given us the opportunity to add the 12m Horsch Avatar drill, another 1200 tons of on-floor grain storage, and a bigger 3-ton grain bucket!

I also have a bee in my bonnet about the use and safety of bulk seed bags! When you have 2 tons of seed hanging above your head with the telehandler boom at full extension on a windy October evening, safety definitely comes into focus! With that said, we are looking closely at building a drill filling



Prepping shed base before laying the floor

trailer that handles bulk seed straight into the drill. With the appetite of our 12m drill, we really need a hopper to hold 12-15 tons for a good day's drilling. So something along the lines of an ex-gritter body paired up with a folding hydraulic auger looks to be what we're thinking at the moment. That's for next winter, though!

So back to my "one step back"! This spring, my independent agronomist has decided to move on, and he has been replaced by a friend of mine and one of the "Nutters." Tom Reynolds is a farm manager and contractor in East Kent but will now split his time between his farming business and some agronomy for Edaphos, whose services we employ for all things agronomy, soils, and nutrition.

On his first visit, he recommended that we spray off quite a few fields of very patchy winter beans, which had unacceptable levels of black grass. This was a painful but correct decision and earned him the nickname "Roundup Reynolds"! On his second visit, we had just planted our spring oats, which were emerging beautifully. However, the blackgrass was emerging just as quickly, despite 3 or 4 flushes since last harvest! I even sprayed glyphosate the day before drilling! So, Tom's second job was to recommend spraying off another large chunk. "It's the right decision long term," he told me, but that doesn't take away the pain of spraying out a beautifully even crop and the impending embarrassment of golden fields dying off, which can be seen for miles! It seems from talking to others



Pile of mixed raspberry and strawberry compost



Beautiful crop of black grass

that I'm not alone in my ability to grow an incredible crop of problematic grass?! I'm sure every blackgrass seed in Kent has grown legs and marched ant-like to my farm with an ability to spot the sprayer entering the field. At this point, they all go and hide under a stone, then decide to grow. This zero-tolerance approach to blackgrass seems to be the only option. Selective herbicides seem to have become utterly useless this year. We are also seeing a fair bit of septoria on wheat crops and BYDV in odd patches.

On the whole, though, wheat crops look full of potential. 150 kg of N has been applied in 2 or 3 splits in liquid form, and a foliar AF Nitrogen will be applied at the T3 stage. We will then assess whether we push for 13% protein, based on tissue tests and advice from Edaphos.

We have been busy bringing more compost onto the farm from a neighbouring soft-fruit grower. Strawberry compost is finer and looks like coffee grounds. Raspberry compost is far coarser and really needs a year before it's ready to spread. We will try to turn this a few times and produce something that really improves the land it's applied to. With show season about to start, I'm still undecided as to which ones I'll attend. I've always been reluctant to spend money to attend an event where people spend all day trying to sell me things, be that machinery, services, or their latest book! With a grain store floor to lay and 240m of mastic sealant to apply, my time may be better spent getting everything ready for harvest! Let's hope June brings us plenty of sunshine with an occasional shower, but not just after I've rowed up all my hay!! Have a safe and bountiful harvest, everyone.

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DRILL MANUFACTURERS IN FOCUS...



WHAT A DIFFERENCE A YEAR MAKES!



Coping with the ups and downs of the farming industry necessitates being as efficient as possible, says Jeff Claydon, Suffolk arable crop producer and inventor of the Claydon Opti-Till® direct strip seeding system.

26 May 2023

The contrast between this season and last is dramatic, not just in terms of the weather but also the finances of farming. They are making for a real rollercoaster ride, and I'll admit that being on this fast-moving 'big dipper', unable to work out where or when it will end, is somewhat scary right now. It's a white-knuckle experience that is not for the faint hearted, nor those wanting a predictable, risk-free life, but as farmers we must keep on growing.

Last spring was very dry on the Claydon farm. From 1 January until harvest finished during the first week of August, we recorded just 244mm of rain, while September remained very dry. At the time of writing, we've already had 306mm this year, 58mm of

that between 1 January and 15 February, while temperatures have been significantly lower. Whatever happened to spring?

When I sat down to write my article for the last issue of Direct Driller on 15 February fields earmarked for spring oats were in excellent condition and ideal for drilling, but for one thing. Temperatures were fluctuating between - 2°C at night and +13°C in the day, the soil remained cold and resisting the temptation to rush out with our new 6m Claydon Evolution drill required great restraint. Even though spring oats favour early sowing it was too cold to establish the 77ha of Elsoms Lion, so we held off for a few more days, but when the weather forecast showed rain, we decided to drill and I'm very glad we did. It was one of the best decisions made this season.



The Claydon TerraBlade did a really good job of removing blackgrass



The crop is strong and very clean, with few weeds between the rows.



The strip seeded rows are largely clear of weeds where the TerraBlade was used.

Last year's very dry spring quickly became a distant memory as the weather turned very wet for an extended period, creating serious challenges on many farms. Just after we finished drilling the spring oats at 120kg/ha down came the rain which, given the excellent condition of the soil, meant that there was no need to roll. Almost every day in March and April was wet and with almost 250mm of rain in just a few weeks, more than the first eight months of 2022, we were unable to do anything on the land, so I was pleased we drilled when we did.

It has been interesting to note that the more passes we carried out with the Claydon Straw Harrow last autumn the better the control of weeds and volunteers in the following crops. After four or five passes with this fast, cheap-to-operate implement, far fewer weeds remained than where we did just two. Given the almost toxic effect which over-wintering blackgrass seems to have on the soil and subsequent crops it's very important to take them out while still small, because once established they become much more difficult to remove. All the evidence points to the fact that you cannot do too many passes with the Straw Harrow, something, even as its designer, I tend to forget.

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OSR is a cause for concern

Oilseed rape is a very different story to that of the spring oats. Of the 61ha of DK Excited we drilled, about 5ha was severely affected by cabbage stem flea beetle and slugs before the year-end. In mid-January Astrokerb® herbicide was applied to take out grass weeds, except on the small area we had decided to redrill with spring oats. At the beginning of February we went on with 200l/ha of Chafer Niram 35 + S (35%N + 7SO₃), but the seven days of frosty weather after application hit the crop hard.

It was painful to watch what in November had looked to be a potentially excellent crop going backwards at a rapid rate rather than growing strongly. In a few places pigeons and slugs had been an issue over the winter, but were of no real concern, then the cabbage stem flea beetle came in, followed by stem weevil, which completely massacred the stems. From losing small areas we ended up having to write off 30 per cent.

Returning from a holiday in Corfu last week I looked out of the plane windows on the approach to Stansted Airport and was amazed at how little oilseed rape is being grown. Only a few years ago around a third of the land in this key arable area would have been glowing bright yellow at this time of year, but instead I saw only the odd glimpse of it in the patchwork quilt of fields below. The high up-front costs of establishing oilseed rape, pest problems and uncertain returns have put a big question mark over its future, so one wonders how long it will be viable to grow the crop, especially at a time when farmers are trying to reduce inputs and risk.



This field was drilled with oil seed rape in August 2022, but due to pest issues had to be redrilled with spring oats

Wheats are full of potential

On a cheerier note, our wheats look fantastic and full of potential, but again the differences between this season and last are considerable. During the very dry weather in 2022 they were very clean, but this season the combination of a wet spring and our very healthy soils made everything grow, including grassweeds and broadleaved weeds.

Autumn herbicides did a fantastic job up until Christmas, but the wet, cold weather from January onwards seemed to put the brakes on their effectiveness. Our 'dirtiest' wheats are following oilseed rape, which could be due to a lack of persistence from the autumn herbicide, combined with the fact that the low seed rates for hybrid varieties result in a low plant density, allowing light to reach the soil and encouraging blackgrass to grow.

That said, the importance of herbicides is evident, particularly in conjunction with the Claydon TerraBlade inter-row hoe, and that shows up very well in one field where Agrii are running a

blackgrass trial. In the untreated control strip the high level of blackgrass makes it difficult to see the crop, but where certain treatments have been applied it is much reduced. Where herbicides were supported by the TerraBlade, albeit used in far from ideal conditions and too late to be most effective, the results are even better, proving the value of this fast, low-cost technique.



This year's wet conditions encouraged crops to grow strongly but significantly increased the potential for septoria

As the weather warms up, we are seeing a strong flush of blackgrass in the spring oats, which is somewhat disappointing in a crop we'd hoped would help to clean them up. The plan was to take out later germinating weeds with multiple passes of our 6m TerraBlade, but wet weather delayed its use. Most crops were at GS32 before we were able to use the TerraBlade, but at least we were able to go through the spring oats at the end of April when they were at GS30. It did a really good job of removing blackgrass, but I was frustrated knowing that the results could have been so much better had the soil been a little drier.

Last year's very dry weather significantly improved the condition of our soils, but so far this season they have taken a battering. Heavy rain has undone much of the good work, causing the soil to settle and pores to constrict, reducing water movement, forcing oxygen out and encouraging weeds to grow. Hopefully we can now look forward to a period of warm, dry weather through to harvest to help fissure and restructure our soils, then the Claydon Opti-Till® System will help to freshen up them up before we drill in the autumn.

What are they thinking?

Declining crop prices are a huge challenge for the farming sector and represent a very worrying trend. This time last year feed wheat was over £300/t and oilseed rape north of £800/t. It was painful to watch prices fall sharply over the winter and like many I thought that they would bounce back, but that hasn't happened; both are currently trading at just over half what they were then. I sold some of this season's anticipated tonnage forward last autumn, but with the benefit of hindsight clearly it wasn't enough. The big question is 'when will the drop stop'?

Given continuing low prices it will be interesting to see how much UK farmers cut back on fungicides and fertilisers this season. Whilst it is tempting to reduce expenditure on these inputs, experience has taught me that this would be a false economy because the benefits of using them still significantly outweigh the costs.



Wheats on the Claydon farm look fantastic and exhibit excellent potential

I don't need reminding that farming is a risky business, but the key to remaining profitable is to minimise production costs without compromising output. This is critical at a time when BPS payments are on a downward path towards being phased out entirely by 2027. This key component of farm incomes is being eroded by design, yet each time I look at the alternatives it strikes me that their complexity, time and cost leave little reward for participating. I feel that my time is better spent doing other things.

With the agricultural sector facing numerous and increasing risks, the Claydon farm's ethos is to keep things as simple as possible, operating as efficiently and effectively as possible whilst maintaining yields. The Opti-Till® System enables us to establish crops at very low cost using just 15 litres of diesel

per hectare and we fine-tune inputs to maintain consistent, above-average yields, with significant additional benefits to soil structure and health.

Looking at the current situation it is difficult to understand what those in government are thinking. At a time when more food is needed to feed a growing population, these here-one-minute, gone-the-next politicians at national and international level appear to be intent on introducing additional, more complex schemes which will reduce the amount of food produced by those of us who are in the business of farming for the long haul.

Nothing is more important than an adequate supply of food at prices which are affordable to consumers but yield a realistic return to compensate farmers for the high level of investment and risk involved in producing it. It begs the question, what are they thinking playing this very dangerous game, akin to Russian roulette, at a time of increasing global uncertainty and instability? We'll probably never know, but as farmers have no alternative other than to keep growing crops despite the challenges.

The Claydon website (claydondrill.com) galleries contain numerous videos on soil health and resilience, as well as showing the Claydon Opti-Till® System being used to establish all types of crops, in all situations, both in the UK and overseas. You can also keep up with the latest posts, photographs, and videos from Claydon and its customers through the Claydon Facebook page www.facebook.com/Claydondrill



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FISH HYDROLYSATE:

A NEW WAY TO ADD TRADITIONAL SUPPORT TO YOUR CROPS

As margins are ever more squeezed on farm, over the last twelve months we have seen a significant increase in farmers looking for a more sustainable and cost-effective way of applying nitrogen to their land while reducing farm inputs. Fish hydrolysates are now playing a key role in that search for solutions and are proven to stimulate soil life and supply nitrogen without the negative impacts attributed to synthetic nitrogen fertilisers.

What is a fish hydrolysate?

Hydrolysis is the process of breaking complex proteins into their component amino acids. These can then be utilised by both the soil microbiome and the plant directly. Fish hydrolysates contain a full range of naturally balanced amino acids and fatty acids. Rich in essential nutrients such as nitrogen, phosphorus, and potassium, they also provide important micronutrients like calcium, magnesium and trace elements in a bioavailable formulation establishing a sound basis for any crop nutritional plan. Fish hydrolysate is also considered more environmentally friendly than synthetic fertilisers, as it is a by-product of the fish industry produced from the transformation of materials that would otherwise go to waste.

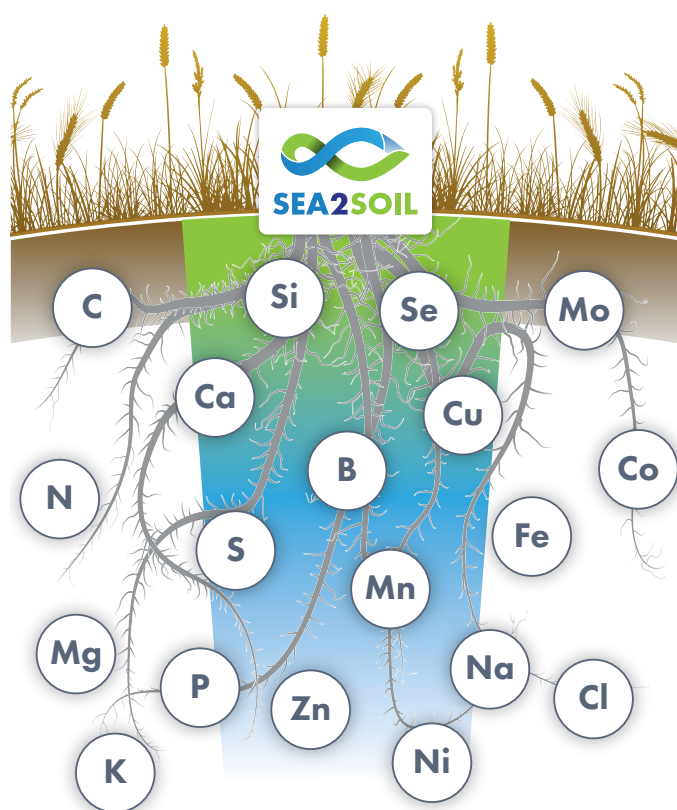
How does fish hydrolysate benefit your soil and crops?

Plants are basically factories taking in CO₂ from the atmosphere and converting it into oxygen and sugars. However, they can't do this efficiently without the assistance of the soil bacteria and fungi. Fish hydrolysate benefits that cycle of conversion by providing a highly nutritious food source for those microorganisms which further convert nutrients into a form that is readily available to the plant. Using fish hydrolysates as an organic soil improver helps to boost and replenish the nutrient content in the soil, promoting plant health and optimal growth.

The key benefits to using fish hydrolysates include:

- **Organic matter and soil conditioning:** Fish hydrolysate promotes a biologically active soil fostering beneficial microorganisms and earth worms. With the creation of a biologically active substrate, the soil exhibits better aeration, can retain moisture and releases nutrients in a biologically available form to the plants, contributing to increased stress tolerance in plants. Promoting better health and growth of the plants.
- **Enhances nutrient availability:** The nutrients in fish hydrolysates are readily available for plants and are easily absorbed through both foliar and root uptake. This results in improved nutrient uptake efficiency and enhanced plant nutrition.
- **Stimulates plant growth and development:** Fish hydrolysates contain natural growth-promoting substances, including amino acids and other beneficial compounds like chelated minerals. These biological active compounds can stimulate root development, enhance vegetation growth, encourage flowering and fruiting and improve overall plant vigour.

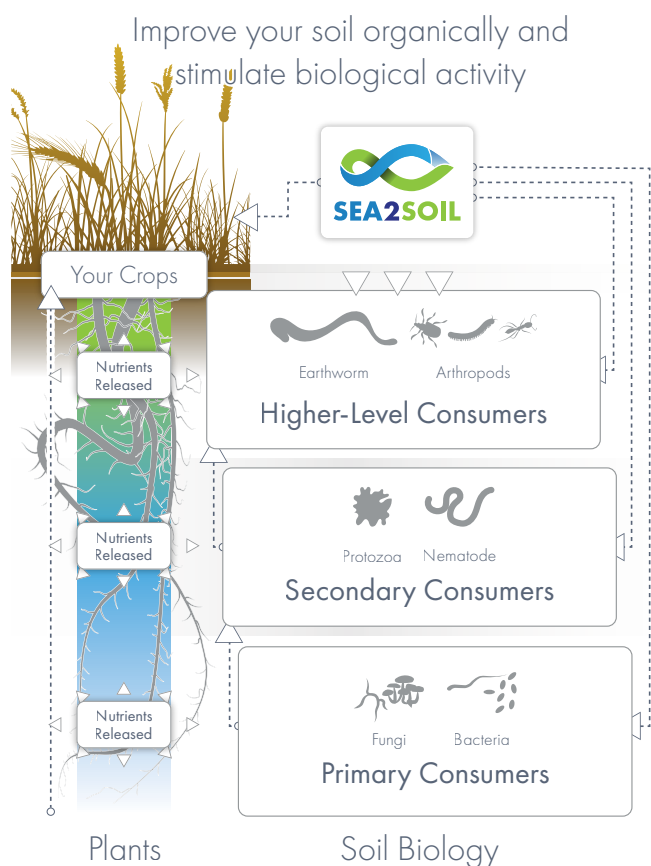
Naturally balanced macro and micro nutrients



What is the importance of amino acids?

Over millennia the soil ecosystem has evolved to recognise decaying organic material, break it down into its constituent components and feed it back to the living plants in what we know today as the nitrogen cycle. In the last century and with the advent of farming with synthetic fertilisers and sprays, this delicate nitrogen cycle is disrupted because a lot of these fertilisers are applied as nitrates. Fish hydrolysate provides a nutrient source from which the soil ecosystem can reduce higher forms of nitrogen in its own time and when needed, rather than being bombarded with high levels of nitrate, the excess of which will ultimately end up in our ground water and rivers.

Each amino acid has specific functions and roles in plant metabolism, growth, and stress response. A balanced supply of essential amino acids is crucial for optimal plant growth



and development. While plants can synthesize some amino acids on their own, they often require a supply of essential amino acids from external sources. One advantage fish hydrolysate has is that it contains all 20 amino acids needed for protein synthesis, which are key metabolites in the process of vegetal tissue formation and chlorophyll synthesis. They also play important roles in nitrogen transport and storage, and the regulation of plant growth and development.

Amino acid naturally occur in two forms L- and D-, fish hydrolysates contain both forms playing a key role in soil and plant health. L- amino acids can be taken up by the plant directly and are used for protein synthesis, whereas the D- amino acids are used in the building of cell walls by soil bacteria, which are crucial to soil health.

Over the last three years Sea2soil has been conducting various farms trials, with the participating farmers reporting an increase in biological activity in their soils, improved carbon capture and a decrease in the amount of synthetic nitrogen and other chemicals they need to apply. Also reported is that farmers are seeing an overall improvement in their return on investment. Sea2Soils Technical Sales Manager, Liz Brown says that, "Sea2Soil can play a key role in a farms total crop nutritional plan, as it provides a nutritional package which is complementary to a soils natural self-regulating activities. Sea2Soil can be incorporated into any farming system wanting to reduce their reliance on synthetic chemical and reducing input costs."



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MY NUFFIELD JOURNEY

By Toby Simpson NSch @tjsimpson (Twitter)

Cast your mind back to January 2021, that particularly cold, dark, and dreary month made infinitely worse by the fact we were in a third lockdown with no end in sight. For me this was the background to an epiphany, while sat by the fire reading through old Nuffield papers, and perhaps after one whisky too many, I concluded that 8 weeks of travelling abroad might be just the tonic I needed to remedy this dark chapter.

I had been contemplating what cover crops to grow in our second year of trying them out. We had recently moved into more of a direct drilling system following 20 years of scratch till during which Dad had consistently improved our predominantly clay loam soils. I had long suspected that cover crops should also have a place on the farm, but I needed to prove it first.

The idea of travelling the world chatting to people about cover crops and soil seemed too good to be true. I first had to clear it with my family who have been incredibly supportive throughout. After that I really didn't know what it involved. Luckily my friend Teresa Meadows had started hers the year before and kindly explained how it all worked; I completed the online application, which is like filling out a CV, and if shortlisted I would be interviewed in London. Simple enough so it seemed, though the addition of a 30 second self-video was completely new to me, and I cringe now watching my first attempts. I settled on the title 'Catch and cover cropping opportunities in UK arable agriculture'.

No sooner had I started to fill out the application that Charlotte Merson, Nuffield's Alumni Officer, was in touch with some helpful tips and ensured I was able to join in with the Chair and Regional Chair on an informative Zoom chat (still a novelty at this point). I continued to feel welcomed and supported throughout the application process.

In September 2021, I attended a regional mock interview during which Tom Chapman, Andrew Scoley and Teresa Meadows questioned me on my subject and motives, while Matt Swain, who later would become my Nuffield mentor, provided first class advice in the waiting room. All of this meant that by the time I reached my London interview in October I was feeling nervous but well prepared, and that the Nuffield community was most certainly something I wanted to be a part of.



Luckily the selection panel seemed to agree. Something I had realised by that point was that it really doesn't matter where you come from or what academic and business credentials you possess, if you are passionate about something and are in

the mindset to learn, then Nuffield is for you. This was further confirmed when I met the rest of the 2022 Scholars at the annual conference training day in November 2021. Pulled from right across the industry, the range of experiences and backgrounds was vast. I felt instantly inadequate as a humble arable farmer having never really done much in the industry before and yet I had never met such a bunch of kind-hearted, brilliantly funny and interesting people - instantly friends for life.

My resounding memory from that first conference was walking into the bar on the first evening as the rest of the delegates were arriving. I couldn't make it two meters before I was engaged in a deep conversation with a complete stranger. Everyone in that room was there to learn and share knowledge, Nuffield Scholars and guests alike. I felt instantly part of a global network of forward thinking and inspiring people, and it was humbling. In the spring of 2022, all the '21 and '22 scholars from around the world attended a first-class Contemporary Scholars Conference in Norfolk hosted by Nuffield UK. Alongside our pre-CSC week in London, it was an amazing opportunity to get to meet everyone undertaking this adventure.

I set out on my Nuffield travels wanting to look at the practicalities of cover cropping and the subsequent opportunities around them, such as integrating livestock, public engagement, and access to private and public funding. I had decided to break my 8 weeks of travel down to manage the work and family life balance, and due to cost only planned to visit places in the northern hemisphere. That gave me a period from post-harvest '22 to spring '23 to see cover crop practices in action.

I headed to Scandinavia in September 2022 and - being famously expensive - I had bought a roof tent for the family Discovery Sport and planned to camp along the way. The





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excitement and nerves I felt on the first morning I set off from home in Cambridgeshire was akin to the first day of university or Sandhurst, but with wellies in my car boot and not an ironing board in sight. I crossed to Hook on the ferry from Harwich then headed to Norway via Germany, Denmark, and Sweden. It was an incredible drive through some stunning scenery. A highlight was camping on the water's edge in Sweden after 10 hours in the car: I jumped straight in and felt the long journey being washed away by the icy water and late summer sun.



The next day I met Else Villadsen and her colleague Maren who had visited my farm before Groundswell with some of their farmers. So, after being questioned by the Norwegian boarder guard about why on earth I was visiting Norway to look at cover crops (it's so absurd it must be true), I was given the grand tour of some incredibly progressive and innovative farms. Given the short growing season and challenging soil it was the perfect place to see what could be achieved with the right mindset.

Not for the last time on my travels, the wheels metaphorically, and almost physically, came off my plan. The famously reliable Land Rover Discovery Sport decided to blow its turbo on my first evening in Norway. Who could have predicted that...

And so, I was on to plan B, or was it C? Relying on the kindness of my hosts and using hotels, hire cars, and flights, I managed to complete the rest of my trip. From there I flew to Copenhagen and visited some incredible farmers, seed breeders, and industry experts in Northern Germany, Denmark, and Sweden. I fell in love with Scandinavia and the kind people there, and I came back home buzzing with ideas and even more questions.

My second trip was to France, taking the Eurostar this time and hiring a car as the ill-fated Discovery was still being 'repatriated'. I drove to Brittany and met Pierre-Yves Donval who proved that being on heavy clay over clay with 1200mm of rain a year on average is no barrier to no-till and cover cropping.

Following the advice of John Miles, I was kindly hosted and put up by the Agrii soils group along with fellow Nuffield 2022 Scholar Chris Taylor. Steve Corbett and a group of Agrii agronomists and farmers from across the UK were in Northern France for a few days to look at trials and presentations from

the French seed breeders Cerience. It was a great couple of days meeting other farmers and advisors, and we were incredibly well looked after by Jerome Vasseur. Before I got the train home, I was able to squeeze another visit in to see Frederic Remy and a quick culture tour of the Louvre!

As I wanted to make the most of the Nuffield opportunity, I had also been visiting some brilliant farmers in the UK whenever I got a chance. Jake Freestone, Martin Lines, Steven Briggs and Ed Horton had all kindly hosted me at some point in the spring of 2022. I put out a tweet in the autumn asking for anyone in the UK who might be happy to show me around and I was inundated with dozens of kind offers, so put a plan together to see as many of them as physically possible.

Over a few weeks in the autumn, I set to and bounced from farm to farm mostly around East Anglia, Lincolnshire, Yorkshire and Gloucestershire. There were so many inspiring and generous farmers who I was able to spend time with and I felt really privileged to have been able to meet them. I wish I could have seen everyone who had offered but I think I would still be going at this point if I had. It proved to me that it certainly isn't strange for farmers to talk about improving soil health and that many had been doing so for years. It is these farmers who are leading the change, the pioneers implementing and experimenting with new things that have forced the rest of the ag industry's research and government policy to follow.

My final trip was to North America in the spring of 2023. By this point I had come across many fascinating ideas and concepts, and we had been trialling integrated livestock grazing and many other things on our farm. But I really needed to add some clarity to all this to bring my Nuffield to a conclusion and make sense of some of the things that had been ever so slightly scrambling my brain.

By now I was well practiced in hiring a car and driving farm to farm meeting fascinating people, I really enjoyed that freedom, being able to follow my nose and recommendations, nothing too fixed in stone. The time driving gave me the opportunity to process my thoughts and catch up on a multitude of audiobooks and podcasts. I travelled from NYC to Cornell University first, then on to western New York state, Ohio, and Ontario, Canada, before heading back to where I started to fly home.

I experienced incredible generosity from everyone I met, including the famous Nuffield hospitality from Canada Chair and cover cropping legend Blake Vince. Again, I met so many inspiring and pioneering farmers including Donn Branton and his son Chad.

The highlight was meeting David Brandt, a no-till and cover cropping godfather with over 50 years of experience. For me this was where everything came together and made sense. I could see what happens when you look after your soil for so long and have that right mindset of always wanting to learn and try things. Sadly, as I write this, I have learned that David passed away today, only three weeks after visiting him. Having spoken to many others who knew him well I can only begin to imagine how many people he has mentored and inspired, and his legacy will undoubtedly continue to do so.

As I reflect on the journey I have been on over the last two years, I cannot overstate just how incredible the experience has been for me. I have met the most inspiring and kind people



while spending time in breath-taking landscapes, and it has given me the chance to step away from my business with an open mind to learn and challenge ideas. I come back home now with huge enthusiasm and a hunger to keep learning and sharing ideas with people. I have the small task now of writing up my Nuffield report, creating a three-minute video of my travels, then presenting it all at the November 'Super Conference' in Exeter.

I certainly have come back with more questions than answers, but I also am looking at the farm and our soils in a completely different way than when I first set out. For anyone interested in more detail about my Nuffield and findings the report will be out later this year.

I would like to encourage anyone thinking of applying for a Nuffield Scholarship to just do it. There is never a good time,

and it has been hard to get the balance between work, family, and travels right. But anything worth doing never came easy. I would also highly recommend anyone who is after a great couple of days out and enjoys sharing ideas with strangers to attend the Nuffield conference in November. Tickets are open to everyone regardless of who or what you know, and there are always brilliant speakers, Nuffield presentations, and incredible hospitality.

I would like to thank my generous sponsor McDonald's UK & Ireland, my family, and friends for being the support network that has allowed me to step out of my life and do this, as well as everyone I have met and chatted to along the way, even briefly, for being so generous with their time and knowledge.

Applications for 2024 Nuffield Scholarships are open until 31st July – for more details, please visit www.nuffieldscholar.org.

Toby will present his findings alongside nearly 40 other Scholars at the 2023 Nuffield Farming 'Super Conference' held 14-16th November at Sandy Park in Exeter. The event includes two days of Scholar presentations and a pre-conference visit to nearby Wastenage Farms, and tickets are not exclusive to Nuffield Scholars - ALL are welcome and encouraged to attend. Ticketing details, a full conference programme and a full list of presenting Scholars can be found at the QR code or on www.nuffieldscholar.org.



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DRILL MANUFACTURER IN FOCUS...



NEW MODEL NOVAG T-FORCEPLUS 250: NO-TILL WITH LOW INITIAL WEIGHT AND THE FLEXIBLE BALLASTING

Triesdorf, 28.4.2023 The French agricultural machinery manufacturer Novag is expanding its product portfolio of modern no-till machines from 1 to 10m working width in the lower size segment: the new Novag T-ForcePlus 250 offers variable working widths between 2 and 3m, up to 12 coulters and closes the gap between the Novag T-ForcePlus 150 (1 to 2m, maximum 8 coulters) and Novag T-ForcePlus 350 (3m, maximum 18 coulters) models.

Focus on Southern Germany, Austria and Switzerland

Whilst the smaller model (Novag T-ForcePlus 150) is used in viticulture (especially by contractors working with grape harvesters, and for the insert of plots in trials) and the larger model (Novag T-ForcePlus 350) is used on farms with 100 to 400ha of arable land, Novag has developed the new Novag T-ForcePlus 250, a compact machine especially geared to small-structured farms in southern Germany, Austria and Switzerland. It is just as suitable for self-mechanisation as it is for machinery cooperatives.

"We are experiencing an increasing interest in no-till and conservation agriculture on the part of these family farms - whether for arable farming or grassland. They are mainly concerned about high yield fluctuations and acknowledge the connection between soil, and animal health," explains Cedric Köster, Customer Success Manager, Novag GmbH, Germany.

The shedding of ballast

In addition to small fields and slopes, the challenges there are the heavy soils that are usually hard during dry periods in the spring, and wet in the autumn with a low load-bearing capacity. Here, compact no-till technology is needed that does not put too much weight on the soil in autumn but provides sufficient coulters pressure in spring.

"At the heart of our no-till technology is our unique Novag T-SlotPlus sowing coulters system, the benefits of which we are now making available to these family farms with the new Novag T-ForcePlus 250. This is only possible by allowing us to shed ballast on steep surfaces in wet conditions", says Ramzi Frikha,



CEO and Export Manager at Novag. He is the creative head of the company and developer of the new Novag T-ForcePlus 250.

Novag develops and builds no-till technology for the Conservation Agriculture (CA) farming concept, which is based on the renunciation of mechanical tillage, permanent soil cover and crop diversity of at least three species in the crop rotation. The technology must therefore be able to cope with dense mulch layers and sometimes hard soils. Accordingly, it is robustly built and is equipped with a unique coulters system that works trouble-free at 12 km/h, even with heavy crop residues.

Novag T-SlotPlus coulters system

The T-SlotPlus coulters system consists of a large vertically operating cutting disc (576 mm) with two separate sowing boots. The cutting disc cuts the green material or stubble to "open up" the soil. The sowing boot clears the seed furrows and places either seed or fertiliser to the right and left of the cutting disc and above its working depth. This creates the image of an inverted T in the soil cross-section. The cutting disc pulls overlying straw residues into the soil below the seed horizon and thus prevents the negative effects of hairpinning. The seed is transported by the air flow of the pneumatic distribution system into the horizontal pocket of the sowing coulters, where it has optimum contact with the soil but does not come into contact with straw residues. Two trailing V-shaped pressure rollers close the seed slot. The Novag T-SlotPlus system interferes only minimally with the soil. 90 % of the ground cover remains undisturbed during sowing. This protects it from drying out and significantly reduces weed pressure, but, depending on the hardness of the soil and the intensity of the biomass growth, requires high coulters pressures of up to 500 kg and a high machine ballast weight.

Weight adjustments desired

For the markets of southern Germany, Austria and Switzerland, Ramzi Frikha has therefore designed the new Novag T-ForcePlus 250 to be more compact, with a low initial weight and flexible ballasting. The previous Novag T-ForcePlus 350 offered no flexibility in terms of its weight (6.5t empty with 12 coulters) and

working width (3m) and, with its dimensions of 6.5m in length, 2.9m in height and 4200l tank volume, is oversized for these farms.

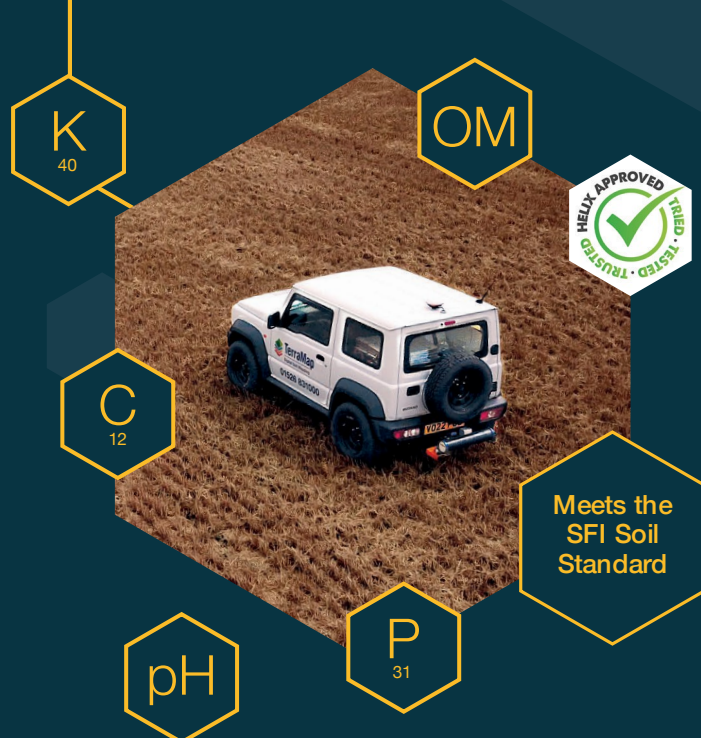


The new Novag T-ForcePlus 250, on the other hand, in its largest version, also with a working width of 3 m and the maximum number of 12 coulters when empty, weighs just over half (3.6t) of the Novag T-ForcePlus 350 and can therefore sow even in wet, autumnal conditions. In hard ground conditions in summer, the axle can be ballasted with up to 1.95t as required. A total of 39 weight plates of 50kg each are available for this purpose, which can be stacked and bolted directly on the axle and above the tyres.

The Novag T-ForcePlus 250 has a smaller tank (800l seed + 300l fertiliser) and smaller tyres. It is 1.2m shorter, more manoeuvrable and requires a tractor power of 70-120hp. Its reduced overall height (2,35m) with a lower centre of gravity is particularly advantageous on sloping ground, which is why Novag also sees it for intercrop sowing in orchards or fruit plantations. The smallest version with 2m, is also suited for viticulture, depending on the distance between vine rows. All these customers are ultimately concerned with the health of their soils - erosion control, improved rainfall infiltration and bearing capacity.

Possibility of customised configurations

Novag manufactures each machine to order and allows individual configurations. With the new Novag T-ForcePlus 250, the customer can choose a working width between 2 and 3m, and the number of coulters, up to a maximum of 12. As with all other models, row spacings of 16.67cm, 18.75cm and 25cm are available from factory and the sowing depth can be individually adjusted from 0cm to 10cm. All Novag models are equipped as standard with the IntelliForcePlus automatic coulter pressure control system, which can be controlled via a 7-inch monitor and joystick. It hydraulically regulates the contact pressure on the coulters from 100 to 500kg. For simultaneous metering of seed and fertiliser, all Novag no-tillers are equipped with a two-part main hopper. On the new Novag T-ForcePlus 250, two additional 50l tanks are available as an option, for example, for slug pellets, fine seeds or special micronutrients. They either dose into the air flow of the main tanks or distribute over a wide area in front of or behind the machine. All four tanks are controlled from the monitor and are each equipped with a hydraulic metering unit, capacitive sensors and individual calibration. All Novag units offer the option of site-specific seeding. The first Novag T-ForcePlus 250 with 12 coulters and a working width of 3 m will go to an arable farm with hilly and uneven terrain in Tuscany, which is switching to no-till conservation agriculture due to intense erosion problems.



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AGRONOMIST IN FOCUS...

IT'S ALL ABOUT THE SOIL

Written by Dick Neale from Hutchinsons



Dick Neale

It's all about the soil - this is now a well understand driver of sustainable farming systems. Being in a position to reduce inputs, change cultivation techniques or understand how cover or catch crops might benefit the soil, has to start with the soil, its condition and improvements required.

Whether you're a farmer that has already moved to a more resilient farming model, or are just starting out, the most important question is to ask yourself is why?

"Many growers will know what they want to achieve or where they want to get to, but unless they know where they are starting from, it is difficult to know which direction to go and the consequences of action taken. Understanding the soil in order to establish a starting point is key and will enable an action plan," says Dick Neale technical manager at at crop production specialists Hutchinsons.

"I always say the machine is irrelevant, it is what the soil needs that should drive the decision - for example a change in cultivation strategy."

"Everyone is farming with different soils, skill sets and objectives - and that's what makes baseline measurements so important, he believes. "It's important to avoid trying to do everything at once."

"Baselining means looking at the three pillars of soils - physical, chemical and biological - and understanding what those mean in terms of the growing crop. It helps every decision you will make on the farm - for example, about cultivation and establishment; rotations; soil and crop strategy; catch and cover crops; livestock integration and manures; and machinery requirements."

"Guessing these won't lead to optimum economic outcomes," he says.

"It's also worth remembering that knowing your baseline provides a good opportunity to engage with the SFI Soils Standard, currently worth upto £44/ha.. "

"Physics, chemistry, and biology - they all work together, you can't separate them. But as an industry, we have separated them.

"Focussing on all three elements gives clues as to how the soil is functioning and cycling nutrients, and these clues can be followed and lead to solutions to improve all aspects and

make potentially unavailable nutrients in the soil available to plants for example."

"We've been focusing on physics and chemistry because they're easy. For example, the field is green and when I spray it with glyphosate, it goes brown or a cultivation input gives an instant result."

Biology is far more difficult to engage with, he highlights. "I think the reason we've not done a lot with biology is that it has slower impact and takes longer to fully demonstrate the benefits . But biology is fundamental to all soil functions."

For a clearer picture of the levels of biology in the soil, Mr Neale suggests the Soil Life Monitor (PLFA) test which is a lab test measuring the levels of bacterial, fungi and protozoa



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in the soil, as well as the quantity of microbial biomass.

"This is a very useful test to see how diverse your soil biology really is, the more diverse, the better the soil performs, but this test allows us to monitor that changes made are actually improving the biological profile over time."

"It is possible to create a soils benchmark using a Healthy Soils assessment and a soil type focussed Hutchinson Gold soil test. If soils are variable this base approach can be build on further using the unique data from TerraMap," he says. "These technologies and services have really come along way into giving us an understanding of the soil that we would not previously been able to do."

Creating a soil benchmark will allow you to pinpoint where high impact outcomes will come from:

- Understand the difference between pH and buffer pH- allows for an understanding of soil base functions
- Know the cation exchange capacity – how big is your soil
- Bulk density and texture – what is your soils structure chocolate sponge cake or brownie
- Organic matter – different layers from LOI OM, dumas carbon, active carbon, carbon to clay layer and C:N ratio
- Extractable nutrients – what are your reserves, focus on "cycle rather than more-on", how are other soil parameters affecting this?
- VESS physical soil structure test, water infiltration, worm count

"Once a baseline of all these factors has been established, create a report or action plan that all of the teams across the business are fully engaged with."

Understanding where using the various different soil tests and technologies to best effect is important, says Mr Neale. "For example If you've got variable soils, Terramap allows you to understand where those variations are and make some really impactful decisions. If soils are pretty consistent across the field or farm there is less significant benefit to be gained from Terramap.

"For those who want an even deeper understanding of the soils dynamics, the launch of Hutchinsons Terramap Gold service earlier this year marks a step forward in the ability to analyse and map soils with even greater precision," he adds.

"Terramap Gold provides a thorough insight into the soil's building blocks and why it behaves in a certain way. That performance may be good, or bad, but knowing exactly what is happening beneath the surface is the starting point for more effective decisions around cultivation strategy, organic matter applications, liming, primary objective of cover crops or the amount and type fertiliser to apply."



Ed Brown, Head of Agroecology

Having created a baseline measurement, then comes the what next question. Ed Brown, Head of Agroecology, believes that any transition or journey into Agroecology should encompass six principles of soil management.

"These should guide every decision on the farm," he says. "It's about being flexible depending on the season and soil type- don't be dogged in your decision making."

1. Minimising disturbance - the underlying premise of this is to move soils as little as possible but as much as necessary. Some soils may be able to cope with direct drilling straight away, but more often than not, there are several steps to get to this stage throughout the rotation.

It is important to understand that this does not always require buying new kit! Existing kit can be adapted or simply used in a different way, or working with neighbors or contractors to bring in the right machinery for the job at the time.

Minimising and targetting use of chemicals is a key part of this, and should be achievable once the soils have improved enough to cope with reducing overall inputs.

2. Retaining soil cover -never leave any soil bare, this overlaps with keeping living roots in the soil all year around, there should always be something growing in and on the soil. In doing so, residues are available for worms to feed on for example, and the cover protects the soil from heavy rain and temperatures fluctuations
3. Maintaining living roots – these help to stabilise, structure and aerate the soil while providing drainage channels. They also feed soil organisms with carbon rich exudates and are fundamental to building microbial biomass in the soil.
4. Maximise diversity by using a varied rotation and avoiding monocultures, this can include intercropping, companion cropping, variety blends, catch and cover crops.
5. Integrating livestock - this is not always essential and requires further thoughts about how to do this. It must work for your situation. If it does fit, then having livestock does mean that goals can usually be achieved faster and to a greater extent. For example reducing fertiliser and increasing OM. It's a form of enterprise stacking, getting more from the same land.
6. Finally, keep an open mind! Be prepared to challenge conventional thinking and practices and trial new ideas and techniques to work out which is best for your farm.



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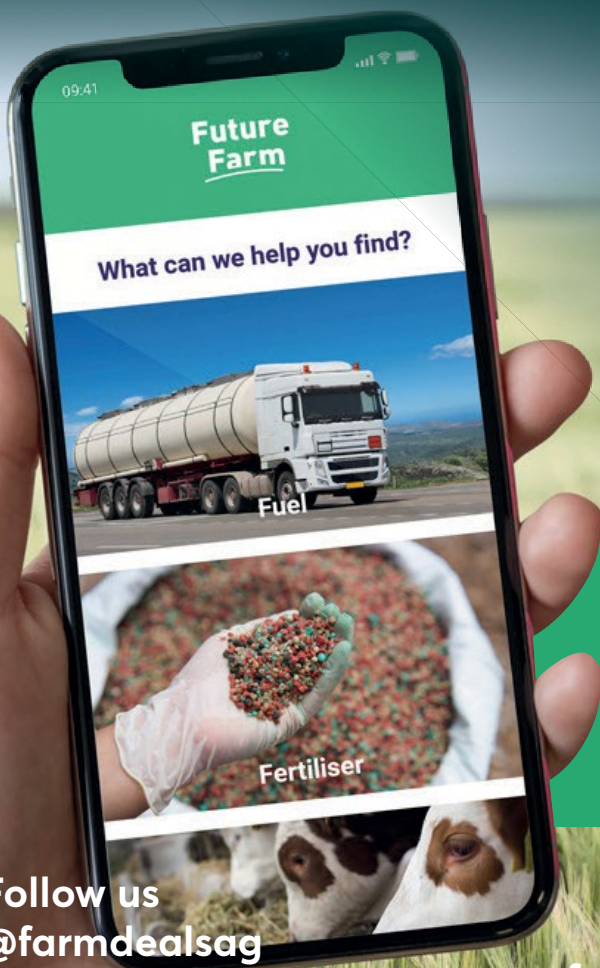
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EASING THE TRANSITION

While financial and environmental pressures mount, so does our dependency on our soil. For those stepping away from conventional approaches, it can be a hard journey. Mark Shaw, UK manager at Gaïago, explains how microbes and natural substances can ease the transition, maintaining yields and building structure.

Transitioning soils to new, more sustainable, production systems can be a long and sometimes, difficult process. It can take years to rebuild a high functioning soil biome.

The reason is fairly straight forward; the food web beneath our feet is complex. Cultivations and synthetic inputs, directly and indirectly, damage the network of interconnected relationships and the organisms themselves. Tillage, for example, disrupts the habitat of macro-organisms like earthworms.

While we're squaring the circle regarding tillage, and integrated pest management is making strides in protecting crops from weeds, pests and disease, crop nutrition is largely unresolved.

In natural ecosystems, the network of fungi is well established. Their hyphae extend into nearly every crack and pore in the soil's structure, unhindered by cultivations and compaction. Some extend into plant roots, exchanging water, dissolved nutrients, enzymes

and hormones for carbon-rich root exudates.

Living alongside them, in the soil and in plant roots, are bacteria and a wide range of other micro- and macro-organisms. Together, they maintain a rough equilibrium where plants thrive, in no small part, due to the water and nutrients the micro-organisms supply. This soil biome has taken many years to develop; the relationships are well established and the populations of different species finely balanced.

In fields that have farmed with extensive use of tillage, crop protection products and artificial nutrients, the soil's ecosystem has been largely destroyed. It, therefore, takes time and the right conditions for populations at each trophic level to rebuild and relationships to reform.

Soil revitalisation

Fortunately, there are solutions that can ease the transition. Gaïago, a company specialising in innovative

soil revitalisation solutions, was co-founded by Francis Bucaille, and Samuel Marquet who are both experienced soil specialists and farmers. They have dedicated years of research and development to understanding soil and developing solutions that protect yields, supporting growers that are reducing synthetic inputs.

FreePK, for example, is a root probiotic based on *Bacillus mucilaginosus* – a bacteria that produces organic acids which solubilises mineral nutrients, making them available to plants. Its synergistic relationship with plants influences growth hormones and promotes the development of strong and healthy roots.

In trials in Northern France, Free PK has been shown to increase the absorption of potassium, phosphorous and magnesium in potatoes, resulting in a 2t/ha increase in yield. Likewise, European maize trials have demonstrated 0.7t/ha yield increases.

But it's not just the nutrients locked-

up minerals which can be harnessed by plants via microbes. Azobacter Chroococcum is a free-living nitrogen-fixing bacteria, capable of capturing nitrogen from the atmosphere, transforming into an assimilable form.

Just as in those natural ecosystems, it's the plant-microbe relationship that regulates the supply of nitrogen throughout the growth cycle and ensures there's neither a famine nor a feast.

In contrast to artificial fertiliser, applying microbes like Azobacter Chroococcum in Gaiago's Free N100, can't leach and therefore isn't counted in fertiliser plans, yet is proven to deliver the equivalent of 30kg N /ha, when the crop needs it. From wheat and barley, through rape and maize, to sunflower and sugar beet, trials have shown that Free N100 can help growers maintain yield while reducing nitrogen fertiliser.

As well as adding beneficial microbes, it's possible to stimulate those that are already present. Nutrigeo is a soil prebiotic that contains organic acids, polysaccharides and complex trace elements. Its formulation activates



Mark Shaw, UK manager at Gaiago

humifying flora, increasing fungi production of mycelial hyphae and the secretion of fungal mucilage which helps with microaggregation of soil particles, creating and maintaining microporosity.

The fungi are part of the basal layer, decomposing crop residues and manure. They mineralise nutrients as well as stabilising organic matter and increasing the cation exchange capacity of soils.

It's a useful tool where growers are seeking to support the agroecological transition process.

With climate change already influencing our weather patterns, it's essential that we make the most of soils' ability to capture atmospheric carbon and stimulate biodiversity. It's also proving beneficial for the bottom line. As Gaiago's saying goes **"mankind thrives, when soil thrives"**.

The infographic features a large circular background image of a hand holding dark, rich soil. A yellow line curves through the image, connecting different sections. On the left, a yellow circle contains a line graph icon, with the text 'Measure Where you are today' below it. At the bottom left, the text 'Supporting your soil health journey' is written in large white font. At the bottom right, a blue circle contains the text 'We can help you achieve your soil health goals; from improving knowledge and skills to benefitting farm profitability and long-term environmental stability.' Below this, it says 'Speak to your Agronomist to take the next steps with us' in yellow. At the bottom center, a yellow circle contains a magnifying glass over a plant icon, with the text 'Investigate Where you want to go' above it. In the top right corner is the Agrovista logo (a blue circle with a white 'a') and the text 'agrovista soil health'. At the bottom right are social media icons for LinkedIn, Facebook, Instagram, and Twitter, followed by '@AgrovistaUK'. A QR code is located in the bottom right corner. The website address 'www.agrovista.co.uk/soil-health' is at the very bottom.

Measure
Where you are today

Supporting your
soil health journey

Investigate
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We can help you achieve your soil health goals; from improving knowledge and skills to benefitting farm profitability and long-term environmental stability.

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FARMER FOCUS

THOMAS GENT



Completing my last ever BPS application last month really got me thinking about the financial future of our farm. We all know the era of the Basic Payment Scheme and money for simply owning land is drawing to a close. So, what does the future look like and how can we ensure that our businesses are financially stable because of course we cannot hope to be environmentally sustainable if we are in the red.

The first area to look at for all good businesses is that of controlling cost. For us on our 800 ha farm in South Lincolnshire this was the sole reason we made the transition to direct drilling around 15 years ago. At that time our traditional machinery was coming to the end of its useful life and we had a decision to either invest in new very expensive machinery or try this new thing Grandad had seen in Argentina called Direct Drilling. 15 years on and doing some recent benchmarking it has been amazing to see just how cost effective this form of farming can be compared to the more traditional heavy cultivation way of operating.

Over a 3 year average looking at winter wheat our yield and income was almost identical to that of our conventional farming neighbours. However, the cost is where things get interesting. Our variable costs were around 17% below the average and our fixed costs were around 40% below the average. Of course, this is no scientific study and weather etc make a huge difference. But it does give me encouragement that we are moving in the right direction. The question Dad and I ponder now is how can we knock off the next 10%+ of costs? (while maintaining our yields). Like with many things the taking away the first costs was the easier bit for example our nitrogen application has come down from approximately 200 KG/N per ha to more like 160 KG/N per ha (in winter wheat) whilst maintaining our 9-10 tonne average yield. But how do we get below



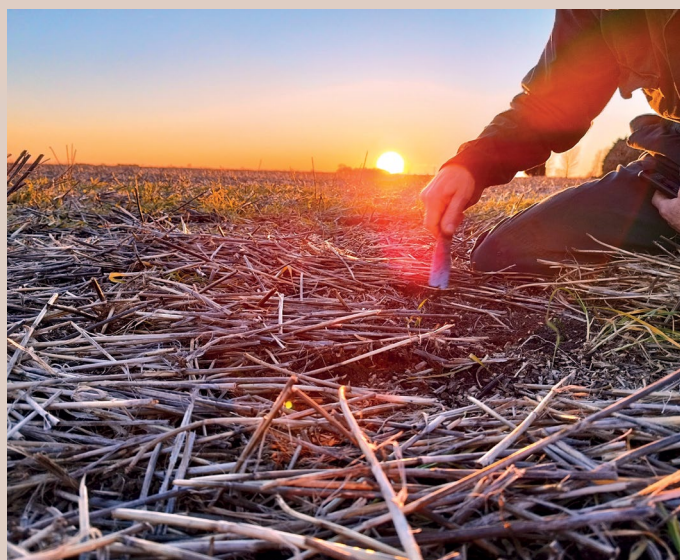
the 100 mark? It is clear to me the next stages are going to require more radical thinking, probably with the use of legume leys or ideally a permanent understorey. In summary though I think we are getting to a point where cost control is becoming more and more tricky.

So the next question is how can we tackle the other side of the equation and how can we increase the income side. We know money for owning land payments are disappearing and whilst I do think there are some great options now coming through countryside stewardship and SFI they generally all come with cost as well. There will be an increase in payments for delivering environmental goods either through private or public funding techniques. But the lion's share of the money I earn will continue to come from the food I produce as it should. I am a commodity grain grower. I grow a range of different crops in my rotation now: Wheat, Oats, OSR (decreasingly) and Field Beans. To shorten my supply chain and diversify my rotation I have also started growing for the British Quinoa company as well as forage rye and grass for a local AD plant.

However, I recently came across an interesting report by Sustain ("Unpicking food prices: Where does your food pound go, and why do farmers get so little?"). To pull out an interesting statement in this report "the cereal farmer spends 9.03p yet receives an almost negligible profit (0.09p) on a selling price of £1.14" and "For 4 beefburgers the processor gains ten times the profit of the beef farmer. A carrot grower spending 14p per bag and selling to the supermarket supply chain gets almost negligible returns."

Whilst there are reasons for this such as the amount of cost required to process and market a product to a consumer and I am sure many will argue around the specific numbers it does beg the question in my head, would it be easier to improve the income side of the equation rather than push down the cost side even further? Many will pipe up to say that I could build a farm shop and sell directly. However, this is not something I would be able to do given the area





of the country I am situated in and really I am interested in scale. How can I shift thousands of tonnes through a farm shop? No, the real question is can I leverage my regenerative farming techniques to gain premiums in the market? YES is the answer! But we need to do something we have traditionally not been great at "Marketing".

So, I have started down this journey. I have created my own little brand for my farm called Gentle Farming - www.gentle-farming.co.uk.

I have been hosting farm tours with some of the biggest food companies in the country all in the hope of finding a way to shortcut the supply chain and sell more directly at scale. It has been hugely interesting to help educate them on regenerative farming techniques and to hear their thoughts on how the market is developing. I am making progress, slowly. I am looking forward to the day sometime soon when I can walk into a restaurant knowing my crop which I grew is being sold at scale to real people.



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DRILL MANUFACTURERS IN FOCUS...



Fentech Agri Ltd was established to incorporate the Simtech direct drill company into a more comprehensive systems approach to regenerative and sustainable agriculture.

The core of the business model revolves around enhancing soil health and reducing input requirements. The goal is to achieve maximum yields with minimal input costs, ensuring a solid bottom line profit while simultaneously improving soil quality for future generations.



Direct drilling serves as a key component of the system, but it must be complemented by additional products. The systems are easy to understand and implement, and the machinery is designed to be user-friendly and low-maintenance.

In addition to the established product line of Simtech Direct drills, which feature proven T-slot tines, Fentech Agri also offers ultra-low disturbance subsoiling products utilising Tillso tine technology.

These products facilitate shallow annual or bi-annual restructuring by lifting and dropping the soil over a wing, creating vertical fissures for improved root establishment.

The tines have been developed to cause minimal surface disturbance, reducing the need for subsequent cultivations, preventing weed seeds from dispersing throughout the soil profile, and keeping fine soil particles on the surface.



The "Advantage" product range is available in mounted and trailed formats, ranging from 3m to 6m. Optional extras include row cleaner discs, vertical tillage leading discs, opt-openers for cost-effective drilling of small seeds such as OSR and cover crops, as well as various roller types including the DD diamond packer and flexi-till rubber roller, depending on soil type and conditions. Auto reset options are also available in addition to the standard shear bolt system.

Another essential tool in Fentech Agri's lineup is the "Commander," a shallow tine cultivator that promotes the creation of stale seedbeds. The tines resemble those of a straw rake but are designed to run at a more aggressive angle with the forward speed generating vibrations that create a fine top tilth, disturb weed seeds, and facilitate seed-to-soil contact, moisture retention, and weed germination.

The machine effectively moves and uniformly distributes chopped straw across the field while disrupting slug development. The Commander is used immediately after harvest up until drilling, with intermediate applications of spray to desiccate weeds. It is primarily used behind the



drill to promote seed germination, moisture retention, and achieve a level finish. The machine is offered in widths of 6m, 8m, 10m, and 12m, allowing for rapid coverage within a short operating window. Additionally, vertical tillage discs can be incorporated into the machine to provide a more aggressive tillage option that remains non-inversion.

All the products featured in the Fentech catalogue revolve around direct drilling, particularly the utilisation of the T-slot tine in Simtech machinery.

The drill range spans from 2.4m grass drills to 6m folding arable drills. Several new products are planned for release in 2023, including two new front-mounted hopper models that enable wider drilling using less horsepower and provide more balanced loading of the tractor.



These drills will continue to utilise the reliable Sulky metering systems. A four-toolbar frame will be available for users operating in high trash conditions or for drilling into cover crops.

A trailed kit is being introduced as an intermediate step from a fully mounted machine to a trailed machine, with fully trailed machines set to undergo extensive development and testing before their release in 2024. Machines up to 3m are



offered with two tine spacings, a narrow spacing at 150mm and the more common arable spacing at 187.5mm.

All drills exceeding 3m operate on the wider spacing. Another upcoming machine currently in development is a lightweight folding drill. This machine is designed to cater to both grassland and arable customers, allowing for increased daily acreage coverage while still utilising the more flexible 25mm, less aggressive tine. The hopper capacity will be similar to that of the arable folding drills, with 1700L, but the lightweight frame and absence of a rear spring flex roller make the machine suitable for lower horsepower tractors.

Fentech Agri is enthusiastic about the opportunities presented by transitioning farming practices away from conventional heavy cultivation.

The company is keen to demonstrate that with the right tools, input costs can be reduced while maintaining high yields and improving profitability. The benefits for farmers and the soil from adopting the complete Fentech system can be quickly realised.

While it's important to consider the influence of weather conditions in determining the most appropriate approach, a move toward a no-till system can preemptively address many of these challenges.

Improved drainage, enhanced vertical support for machinery, increased organic matter levels, and improved worm populations are just a few of the many advantages observed, in addition to the financial benefits.

Fentech Agri is open to discussing current farming practices with prospective customers and providing guidance on transitioning toward a more sustainable system in the future.

The company looks forward to engaging with visitors at the Cereals show this year and will be conducting demonstrations of their drills at Groundswell at the end of June for those interested in observing their machines in action.

LIGHT STIMULATION BOOSTS SEED GERMINATION

By Dan Crummett from No Till Farmer USA Magazine

Light-energy treatment developed to kill weed seeds without chemicals also stimulates seed germination.

What began as a method to control the spread of tumbleweed plants in the desert is now showing promise for stimulating agricultural crop seed germination to potentially increase crop yields.

Jon Jackson, president of Global Neighbor, an Ohio-based small business with deep roots in spectral physics research for chemical-free weed control, says his company developed technology for the U.S. Air Force to fight the spread of tumbleweeds on 22 million acres of Edwards Air Force Base in Kern County, Calif. The work, which required weed control without herbicides or disturbance of the desert floor, was funded through a Small Business Investment Research (SBIR) grant administered through the Department of Defense.

"After news of the weed control success at Edwards circulated, we

got a bag of marestail seed in the mail from an Iowa farmer and a note attached which read: 'If you can kill tumbleweed seeds, you can kill the marestail seed in my soybeans. Merry



Jon Jackson, president of Global Neighbor, speaks at the 2023 National No-Tillage Conference about the company's Weed Seed Destroyer, a combine-mounted technology that uses light to make weed seeds incapable of physical germination. The same light energy waves used at lower rates stimulate seed germination and development.

Christmas!" Jackson recalls. "We're not farmers, and until then, we hadn't considered agricultural applications for the technology."

After conferring with many farmers, Global Neighbors began adapting the light-treatment technology to the tough, chemical-resistant weeds faced by the nation's growers. In 2023, the company plans to run a demonstration combine equipped with an on-board light-treatment system to process weed seeds passing through the harvester on their way to the chaff spreader.

"A researcher told us the plants resulting from the treatment were growing like crazy..."

"We found light energy from the bluish-purple segments of the visible light spectrum, along with mid-range infrared rays, damages cells near the seed's surface responsible for root development," Jackson says. "The treated seed is still healthy, but it is incapable of physical germination and the production of a radicle. The seed cannot establish itself in the field."

Jackson says the plant response caught agricultural researchers off guard, so the company built a number of 1/12th scale pilot systems and supplied them to various universities. Researchers could conduct their own studies and replicate Global Neighbor's findings, which led to another surprise for scientists working with the system.

"We got a call from a researcher who told us the system wasn't killing the seeds, but the plants resulting from the treatment were growing like crazy," he says. "We determined one of the LED light tubes in the machine was malfunctioning, and the seeds were only getting about half the energy required to damage them for weed-

control purposes."

That led to the realization that the same light energy waves used at lower rates stimulate seed germination and development. Global Neighbors took that knowledge to the field and discovered the results have promising implications.

"We tested our system in a 100-acre Iowa soybean field using 20 acres of light-stimulated seed and 80 acres of untreated seed," Jackson says. "The 20-acre plot emerged more quickly and showed more robust plant growth and development throughout the season than the surrounding acres. The stimulated seed plot also produced an average of 1.1-1.2 more bushels per acre of yield."

In another on-farm experiment, Jackson says an Ohio alfalfa producer faced with delayed planting was eager to try the light-stimulated seed.

"He planted half his hay meadow with treated seed and the other half with seed directly out of the bag," Jackson says. "By November, the treated acres were up and green, while the untreated acres were still mainly the color of brown soil. The demarcation line between the treatments was obvious."

The options of light-stimulation seed treatment open a number of applications for no-tillers faced with delayed planting or wet, cool planting conditions, as well as improved timing for high-value organic crop producers farming in areas with short growing seasons.

Jackson says Global Neighbor is working on another SBIR project with USDA to build and demonstrate a soybean planter equipped with

light-stimulation technology. Such a system could easily become a permanent part of planting season across much of the nation in coming years.

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FARMER FOCUS

DAVID AGLLEN



Trials and learnings of livestock integration at BHF.

So, calving happened, with a few more issues than we expected. Through our breeding choices we have managed to significantly reduce the level of human intervention at calving over the last 5 years. However, we hit a small bump in the road this year with a handful of caesarians required for larger calves out of heifers. As we breed our own replacements, we perhaps need to look a bit further back in the cow's genetics to weed out these niggles. The same bulls produced many more calves that were small and calved without issue.

We managed to turn calved cows out onto cover crops of rye within a few days of calving. This massively reduced our silage requirement as well as reducing the potential unhealthy issues that build up in a calving shed pre turn out. As well as saving money, the cows milk well on the rye, and this allows the use of the field up until work for the next crop is required, another part of our livestock/arable integration. We plan to calve outside next year, slightly later than we have done inside. When successful, we should no longer have the need to house cattle at all. This has been a goal for a few years now, so fingers crossed.

Spring sowing was completed, eventually. We seemed to wait through the eternity that was the wet month of March. I find lots of rain nerve-wracking at that time of the year, we know the clock is ticking on spring crop yield potential, and we know that every wet day requires a few more dry days before sowing will start. As ever though, the rain did take a break, we managed to start sowing barley on the 4th of April. This was followed by a few stops and starts until conditions settled about a week later, allowing rapid progress to be made. We had to be more patient with cultivated land than with no tilled ground. The improving soil structure allowed sowing to progress at a faster pace. This is the first time



Post and pre-grazing grass covers, dog for scale.

we have seen this happen, demonstrating clearly that soil structure improvements take time and patience.

One of the challenges we have been trying to overcome has been the fickleness of no-till spring barley. We have had many issues over the years with this scenario. Indeed, this challenge forms one of the trials that we are conducting as part of the AHDB Strategic Farm project. We hope to succeed in this respect after 6 years of trials. Whilst not directly part of the trial at the moment, this will change for next year, I have always thought that sheep might be a solution to this tricky no-till crop. So last winter we made a point of grazing down all the cover crops prior to barley that was due to be direct drilled. We grazed the covers down leaving varying degrees of residue behind. As crops look currently, this appears to have helped hugely. Barley sown into fields where the cover crops were eaten right down have established very strongly and will give any conventionally established crop a run for its money in my view. Where we left even a small amount of residue, crop vigour after emergence has not been too good. More residue tended to be left behind the store lambs as they required a higher plain of nutrition for growth, so were moved over fields faster to maintain growth. The ewes on the other can still thrive when left to eat covers right down. So, I think we will prioritise the use of breeding ewes to recycle the cover crop before spring barley in the future. It is amazing just how little residue can upset the growth of a young spring barley plant.

We have had time to digest and analyse the findings from grazing winter cereals with sheep. In mid-May we had a rather colourful outbreak of yellow rust in the only wheat field that we did not graze over the winter. All the surrounding fields were grazed and remained unaffected. Whilst not scientific, or validated by statistically significant



A crop of rye and vetch cut and ready for baling.

plot trials, this observation alone is enough to make winter cereal grazing a planned part of the system every year. I think we can be a bit bolder too, eating the cereals down more in a short period, they will still bounce back quickly with fresh clean growth.

Cattle are all busily munching through grass that is up to their bellies. Grass growth was steady and manageable until mid-May, the weather warmed up over a weekend and everything has gone into overdrive since. The power of nature to catch up amazes me every season. However, conditions are drying rapidly now, and we are starting to think that grass growth is slowing in some fields already. As the dry spell continues, we will have to consider how much residue we leave behind the cows in order to keep some ground cover for moisture preservation reasons.

We are moving the mobs daily at the moment, under the principle that fast grass growth requires a fast-grazing rotation, 21 to 30 days. As the growth slows, we will lengthen the rotation, by grazing smaller areas each day to increase the rest period between grazings, this should allow full recovery of the pasture prior to the next grazing. The difficulty I find is confidently deciding when the growth has actually slowed down. This normally takes the form of a week of thinking about slowing the grazing down, before realising that we need to slow down now, or actually, a week ago. Alternatively, I can go and consult our tame cow, Hazel, to see what she thinks. Whilst she won't give me the answer, she does serve as a calming influence on a really stressful day. Five minutes with her, and you're ready to tackle the world again. Even the children enjoy her company.

Whilst we are pondering over our current grass growth, thoughts and actions are moving ahead to this coming winter. I mentioned in my last article that we grow kale for winter grazing. The kale crop dovetails neatly onto the back of an over wintered cover crop of rye and vetch. We let the cover crop grow until a suitable weather window in May (other technical timing descriptions do exist!). We mow the mixture for baling and wrapping. The bales are then lined up across the field to accompany the kale crop that is strip grazed. The kale is then direct drilled into the stubble, and all bar some fertilizer, weed control and a fair amount of pigeon patrol for the first few weeks, that's the winter feed all set up. This provides a diet that the cows are content and thrive on. The aim is to grow all the winter feed on the fields where it will be eaten. This has reduced the costs hugely, particularly the machinery costs associated with harvesting, carting and feeding the cows during the winter months.

We have had issues with weaned calves not being keen to eat the rye silage and have stepped back to giving them grass silage with the kale. Last winter, we decided to leave the calves on their mothers for 8 weeks more than usual. This meant the calves were on kale with cows eating rye before weaning. The result was the calves learning to eat the rye silage. After weaning, they happily ate the same diet for the remainder of the winter. In hindsight, it is obvious that a calf should learn such things from its mother.

Our next challenge is to sort out cover crop establishment this autumn. Last year we were blessed with an easy, early harvest, meaning that most crops could be established in



Myself discussing grazing strategy with Hazel

August with the seeder. I doubt we are going to get that same opportunity this year, as is more normal up here. With this in mind, we will be revisiting the idea of broadcasting the seed into the standing cereals. We have done this successfully in the past; however we have since stepped up the tramline width to 36m. Broadcasting all the seed evenly to this width will take a little more tinkering in the workshop.



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SFI AND REGENERATIVE FARMING

Written by Ian Gould and Ethan Powell from Oakbank Game and Conservation

As we inch ever closer to knowing more detail regarding the Sustainable Farming Incentive (SFI) and the new government portal for applications (possibly in September), many farmers are trying to make sense of what we do know. So far there has been little financial incentive to change practices on farm substantially, the original payments simply rewarded farmers for what many were already doing. That may be about to change but farmers should always work out the finances of what they are being asked to do compared to the possible downsides of any choices. The Government also needs to better understand that farming is highly volatile and well-intended plans can sometimes require change because of external forces like the weather. Farmers and advisors need to accept a lot of responsibility for using the opportunity to deliver the intended benefits, rather than exploiting any loopholes for pure financial gain, if that happens we can expect more regulation and potentially less money!

Many of the priorities for farmers that are trying to improve their soils and biodiversity are well catered for in the published SFI options, with more to follow I am sure. It is clear that we need to value the longer term benefits that will be delivered by these management changes, rather than focus on the immediate financial offering.

The one area that we do need more clarity on soon is how SFI and Stewardship will sit alongside other potential funding opportunities, such as water company schemes, carbon credits, etc. This "Stacking" of payments could really be a key driver for many farms, but it is essential that we get clear guidance about what is and is not allowed, with rules that are stable and not changing every year.

Eligible CS revenue options for the arable and horticultural soils standard

AB5	Nesting plots for lapwing
AB11	Cultivated areas for arable plants
AB12	Supplementary winter feeding for farmland birds
AB14	Harvested low input cereal
BE3	Management of hedgerows
ED1	Educational access
HS3	Reduced-depth, non-inversion cultivation on historic and archaeological features
HS9	Restricted depth crop establishment to protect archaeology under an arable rotation
OP3	Supplementary feeding for farmland birds (organic)
OR3	Organic conversion - rotational land
OR4	Organic land management - horticulture
OT3	Organic land management - rotational land
OT4	Organic land management - horticulture
SP9	Threatened species supplement
SP10	Administration of group managed agreements supplement

SFI & CS Compatibility

Land under a CS scheme can be entered into an SFI agreement, as long as the land cover and land type are eligible for the standard you choose. The CS options, including their timing, must be compatible with the actions in the standard you choose (see table below).

Similar activities or outcomes will not be double funded through both schemes on the same area of land at the same time. Neither will CS options count towards actions in the SFI standards – for example an area of SW6 Winter cover crops established under CS cannot be used to meet the requirements of the SFI arable and horticultural soils standard.

Ineligible CS revenue option land, including any land currently used for an ineligible rotational CS revenue option, cannot be entered into an SFI

agreement. For example, if you have a 10-hectare field with 1 hectare of AB9 - Winter bird food, this area would automatically be removed from the field parcel in your SFI application, leaving you with 9 hectares to apply on. Once the agreement has started, the rotational CS option can be moved between parcels if needed, as long as the total area of SFI eligible land does not change across your holding. If the area of CS options increases, then you will need to add land to the SFI agreement to accommodate the change at the annual upgrade point.

SFI & Private Finance

Currently, you can enter the same area of land into an SFI standards agreement and a private sector scheme arrangement, such as carbon trading or payments for natural flood management. The approach to private

sector schemes will be reviewed by Defra annually.

Current Soils Standard Summary

Introductory (£22/ha)

- Complete a soil assessment and produce a soil management plan
- Test soil organic matter
- Add organic matter to all land in the standard at least once during the 3-year SFI agreement (can be in the form of cover crops sown to meet next action)
- Have green cover on at least 70% of land in the standard over winter (can be autumn-sown crops, cover crops or weedy stubbles)

Intermediate (£40/ha)

- Complete a soil assessment and produce a soil management plan
- Test soil organic matter
- Add organic matter to all land in the standard at least once during the 3-year agreement (can be in the form of cover crops sown to meet next action)
- Have green cover on at least 50% of land in this level of the standard over winter (can be autumn-sown crops, cover crops or weedy stubbles) and multi-species cover crops on an additional 20% of the land (must contain at least two species from these families: brassica, legume, grass/cereal, herbs)

New Actions for 2023 (Not including CS variations)

Hedgerows standard

Assess and record hedgerow condition (£3/100m one side)

- All hedges in this action must be assessed, and written condition assessment recorded
- Must review and update annually

Maintain existing hedgerow trees, or establish new ones (£10/100m both sides)

- Payment only available for planting in CS
- Must average 1 hedgerow tree/100m across hedgerows entered

Integrated pest management standard

Complete an integrated pest management (IPM) assessment & plan (£989/year)

- BASIS qualified advisor to complete an IPM assessment and written IPM plan
- Must review and update annually

Establish a companion crop (£55/ha)

- Establish a companion crop so it's growing with the main arable or horticultural crop.
- Can be on same area or moved around each year.

No use of insecticide (£45/ha)

- Do not apply any plant protection

products containing insecticide on the land in this action.

- Can be on same area or moved around each year.

Nutrient Management Standard

Complete a nutrient management (NM) assessment & report (£589/year)

- FACTS qualified advisor to complete a NM assessment and written NM plan
- Must review and update annually

Arable and Horticultural Land Standard

Establish and maintain grassy field corners and blocks (£590/ha)

- Sow or naturally regenerate field corners
- Similar to the field corner management option in ELS/HLS

So that is what we know (early June 2023) and we feel confident that many farmers will engage with SFI once the portal is available, it would be daft not to look at the options carefully as there is a lot to be gained. It is certainly not perfect and some farming sectors will be very disappointed at the options available to them at this stage, but keep the faith!

For more help and advice please contact Oakbank by calling 01480 890686 or email info@oakbankgc.co.uk

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SPEEDING UP CEREAL DISEASE SURVEILLANCE



Established nearly 60 years ago, the UK Cereal Pathogen Virulence Survey (UKCPVS) is a constant force in the volatile foliar-disease landscape. Jason Pole, who manages technical communications at AHDB, explains how the project is exploring ways to get disease data out quicker.

Strategic value of UKCPVS

UKCPVS is a long-term strategic project. Set up in 1967, UKCPVS started to:

- Monitor cereal pathogen populations
- Invest in cereal pathology skills (honed towards the needs of UK farmers and plant breeders)
- Curate an expanding database of the UK's cereal pathogen isolates (used to inoculate variety trials)
- Maintain seed stocks of varietal lines (used to classify the pathotypes of cereal diseases in UK crops)

Collectively, the resource is exploited to help understand pathogen population changes, including those seen in the last decade in the wheat **yellow rust population** and, more recently, the wheat **brown rust and stem rust** populations (the latter at no cost to AHDB).

Despite its strategic value, a criticism levelled at the project is that its work is 'behind the curve'.

UKCPVS uses diseased leaf samples from commercial crops. So, just like Recommended Lists (RL) disease ratings, information gleaned from such crops will always reflect what has happened, not what will happen.

However, this doesn't mean things can't get faster.

Young plant resistance

First introduced for the current (2023/24) edition, the RL features young plant resistance (r) and susceptibility (s) data for yellow rust in winter wheat.

In the autumn, a carefully selected isolate subset is screened on young plants of all RL and candidate varieties in growth rooms by UKCPVS.

The results, combined with RL trial data, allow the publication of young plant resistance data before disease takes hold (and in time for the T0 spray window).

The story for the adult plant stage is not so simple.

UKCPVS does comment on unusual findings emerging during adult plant field trials and how observations align with commercial crops.

Certainly, this brings UKCPVS in line with the curve. But can it get ahead of it? Potentially.

Growth room research

Growth rooms are invaluable for testing young plants. But could controlled environments help fast-track adult plant stage tests out of season?

To test the approach, the team grew 15 varieties (with a wide range of resistance ratings) under extended daylength conditions in 2022.

As rust does not develop well under extended daylengths, plants were moved to optimum conditions for the disease after



A wheat plant with yellow rust symptoms in a growth room

inoculation (the team used two yellow rust isolates collected in the 2021 season).

Although strong yellow rust symptoms were observed (see image), disease levels did not align well with those observed in standard adult plant field trials (also conducted in 2022).

It was a disappointing result.

It is also a relatively expensive procedure – with relatively high labour, capital (growth room) and energy costs.

It appears that the approach is a no-goer.

Pathogenomics

The capacity for a yellow rust isolate to cause disease on a variety is coded in its DNA.

With full knowledge of all genes involved in successful infection, it is possible, in theory, to predict what the season has in store for crops (excluding new-race curveballs blown in on the wind).

However, major knowledge gaps mean that full genomic solutions are many years away, despite rapid progress in research.

Researchers at the John Innes Centre (JIC) pioneered the use of the 'MARPLE' (Mobile and Real-time PLant disEase) molecular diagnostic approach that can identify fungal strains in a sample.

For the past four years, the UKCPVS team has used and improved the technology to screen isolates for the presence of 320 yellow rust genes.

They use the genotype data to build a family (phylogenetic) tree.

The technique can detect if something is genetically distinct, speeding up the confirmation of new races.

At present, it is unable to reveal the implications to specific varieties.

However, investment in such techniques could eventually lead to a powerful real-time surveillance system to help

No-tillage, no problem

monitor the presence and abundance of yellow rust strains across the season.

Phenotyping

While the world waits for genomics to provide, nothing beats testing isolate-variety interactions.

Another AHDB-funded, NIAB-led study – called ‘**Yellowhammer**’ – is investigating ‘microphenotyping’.

It is a fascinating approach that uses high-power microscopes to reveal the growth stages of yellow rust.

The technique can capture the earliest infection symptoms and detect the stage at which growth is arrested by any host-defence mechanism.

Microphenotyping has the potential to revolutionise disease monitoring and plant breeding.

Submit a sample to UKCPVS

The potential power of emerging disease monitoring approaches is significant, and they are already making a difference.

However, patience is required. Good things often take time.

If you are itching to make a difference today, why not submit a diseased leaf sample to UKCPVS?

With focus in 2023 on yellow rust and brown rust, it is the peak period for sampling.

How to submit a leaf sample for testing

The success of UKCPVS depends on infected cereal leaf samples received from the field, if you would like to get involved, full sampling instructions are available from the NIAB website.

In 2023, UKCPVS will focus on yellow rust and brown rust. Mildew will not be surveyed in 2023.

Follow these simple guidelines to ensure the sample reaches UKCPVS in the best possible condition allowing the team can isolate the disease.

Yellow Rust and Brown Rust

Samples should consist of 5-10 infected leaves. The rust should be active and fresh-looking to ensure that it is still viable once it reaches us. Fold each leaf length-wise, upper surfaces together and put in a paper envelope with a completed sample form (overleaf), telling us where the sample has come from, and post to UKCPVS using the freepost address.

Mildew

As with the rusts, pick 5-10 infected leaves showing active and fresh-looking disease. Fold leaves lengthwise as before, and place them, with the accompanying form, into a paper envelope and post to the UKCPVS freepost address. It is best to post samples on the same day they are collected and earlier in the week, if possible, to avoid delays in transit. This ensures the samples are in the best possible condition when they arrive.

Click on the QR code to view and print the form for submission with the samples.



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MYCOTOXIN RISK TOOL FOR WHEAT REFRESHED FOR 2023

AHDB

Farmers can calculate rainfall-related mycotoxin risk assessment scores online via a weather-based mapping tool.



About the tool

The tool reveals rainfall levels at hundreds of sites across England and Scotland during the critical winter wheat flowering and pre-harvest periods.

First released in 2019, the tool has been refreshed for the current season.

Dhan Bhandari, who manages grain quality research at AHDB, said: “Rain splash spreads the pathogens responsible for head blight. Some species produce mycotoxins in infected ears, so it’s important that risk is managed.”

In winter wheat, the first rainfall-risk period is during flowering – GS59 (ear completely emerged above flag leaf ligule) to GS69 (flowering complete).

Growth stage	Rainfall total	Risk score
Rainfall at flowering (GS59–69)	> 80 mm	9
	40–80 mm	6
	10–40 mm	3
	< 10 mm	0
Rainfall pre-harvest (GS87 to harvest)	> 120 mm	12
	80–120 mm	9
	40–80 mm	6
	20–40 mm	3
	< 20 mm	0

The second key rainfall risk period is GS87 (hard dough, thumbnail impression held) to harvest.

Generating risk scores

Once the date range for each period is known, it can be entered into the tool, which then calculates the amount of rain that fell and displays the corresponding risk score at each site.

If no field-level rainfall data is available, risk scores from a nearby site in the tool can help guide the completion of the mycotoxin risk assessment.

The Tool

Covering hundreds of sites across England, Scotland and Wales, this map-based tool can show how much rain has fallen during the critical winter wheat flowering and pre-harvest periods. Use this information to help calculate mycotoxin risk assessment scores (required for the combinable crops grain passport).

How to use the mycotoxin rainfall risk tool

1. Enter the start and end dates in the boxes (typed in manually or selected from the pop-up calendar) for the defined rainfall period(s).
2. At each site, a coloured circle reveals the risk score for the defined rainfall period.
3. Float the mouse cursor over a site to show the rainfall (mm) that fell during the defined period.
4. Enter the relevant score(s) onto the risk assessment.

2023 dashboard

You can interact with the BI Dashboard here: <https://ahdb.org.uk/mycotoxin-rainfall-risk-tool-for-cereals>

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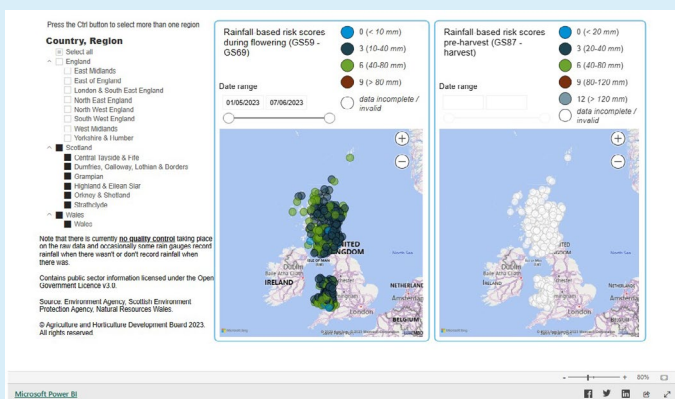
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Fusarium and microdochium in cereals

This complex of diseases, which can be seedborne, soilborne or trashborne, causes a variety of symptoms, including seedling blight, foot/crown rot and ear (head) blight and the production of mycotoxins. Learn about the pathogens and how to manage them.

Symptoms of fusarium and microdochium

Many species of fusarium affect cereals (wheat, barley, oats, rye and triticale), as well as grasses.

Fusarium avenaceum, F. culmorum, F. graminearum, F. poae, F. langsethiae, Microdochium nivale and M. majus

These fungi form a disease complex on seeds, seedlings and adult plants. The seed-borne pathogens Microdochium nivale and M. majus (formerly known collectively as Fusarium nivale) are also included in this group. M. nivale also causes snow mould.

Fusarium seedling blight

M. nivale is the primary pathogen in the group that causes seedling blight. Seedling blight causes pre- and post-emergence damping off. This can result in seedling death and poor establishment. Surviving seedlings may develop a brown lesion around soil level. This can develop into foot and root rot. Symptomless infections can also occur.

Fusarium foot rot/crown rot

Foot rot becomes obvious from late stem extension onwards. It results in dark-brown staining of the lower nodes. Long dark streaks may also appear at the stem base. On older plants, fusarium infection can produce a true foot rot, where the stem base becomes brown and rotten, resulting in lodging and whiteheads. This symptom is less common in the UK but can develop very dry seasons.

Fusarium ear (head) blight

Fusarium species cause a range of symptoms on the ear. Bleached ears often show above the point of infection around the milky ripe stage (GS 75). Later infections may result in infection of the grain without obvious bleaching of the ears. The presence of orange/pink fusarium spores may also be visible on infected spikelets. As the crop ripens, symptoms become less visible. At harvest,



Ear blight infection can cause bleached ears

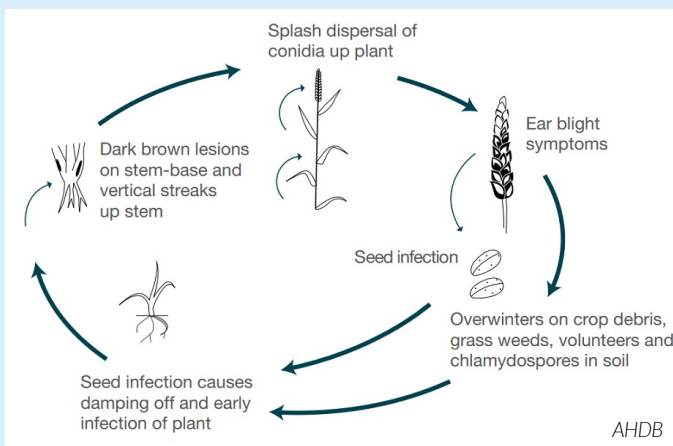
fusarium ear blight can result in shrivelled grains with a chalky white or pink appearance, although this is not always the case. There is little correlation between fusarium-damaged grains and mycotoxin occurrence. Therefore, the presence of ear blight symptoms is not a good indicator of mycotoxin risk.

Life cycle of fusarium and microdochium

Primary infection by fusarium is from infected seed, soil, crop debris and volunteers or host weed species. Spores – from seedling blight or foot rot lesions – that are splashed up the plant or move from leaf to leaf are the main source of ear blight infection. For some fusarium species, spores



Pink grains indicate possible fusarium infection



are also wind-spread, although this is not an important infection source. Ear blight infection occurs during flowering. It infects the grain and completes the life cycle.

Environmental conditions affect disease development and fusarium species have different temperature requirements. For example, *M. nivale* seedling blight is most severe under cool, wet soil conditions, whereas *F. graminearum* seedling blight is most severe under warmer, drier soil conditions. Warm, wet, humid conditions during flowering favours infection by fusarium species, causing ear blights and seed-borne infection. Further rainfall and humid conditions allow secondary infection to occur, allowing further fungal growth and mycotoxin production.

Importance

Most cereal crops develop fusarium symptoms each year. *F. culmorum* and *F. graminearum* are the most commonly found species in the UK that cause ear blights. Although infection by fusarium species can cause poor establishment and lower yields, the most important issue is the production of mycotoxins in the grain by some species (see mycotoxin section below). However, the presence of ear blight is not a good indicator of likely mycotoxin risk. Mycotoxins are present at lower levels in barley and oats compared to wheat. The overall risk of DON exceeding legal limits in wheat is low and in barley and oats is very low.

Wheat

F. graminearum and *M. nivale* cause the most significant seedling losses in UK wheat. However, crops usually compensate from the loss of a few plants through tillering. *F. graminearum* is more common in a maize-producing area, whereas *M. nivale* is more generally distributed. Severe foot rotting in wheat is very rare in the UK because badly infected seed is not used and seed treatments are effective, and losses are generally very small.

High levels of ear blight can occur, especially when conditions are conducive (e.g. wet) during flowering, but yield losses are rarely serious. Seed saved from these crops can suffer from poor establishment, unless the seed is treated with a product effective on fusarium.

The mycotoxins DON and ZON are frequently detected in wheat but average concentrations are usually below the legal limits. Limits are most frequently exceeded in wet harvest years.

Barley

Seedling blight in barley due to fusarium species is rare, but may occur where there are very high infection levels and seed is sown into cold seedbeds. Losses are generally not as high as those seen for wheat.

Early sown spring barley is at more risk of *M. nivale* seedling blight infection.

Ear blight and mycotoxin risk is also lower in barley than

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in wheat, but should be considered if barley is commonly grown in rotation with maize with minimum tillage. Developed for wheat, the AHDB fusarium mycotoxin risk assessment tool is also useful for assessing risk in barley. DON, ZON, HT-2 and T-2 levels in barley have been routinely low with legal limits rarely exceeded.

Oats

Oats are more resistant to fusarium infection than wheat and barley, and it is difficult to see the symptoms in this crop. Symptoms can include premature plant death or bleaching of spikelets. *F. langsethiae* is the predominant species that infects oats and produces the mycotoxins HT-2 and T-2. There is good evidence that at least 90% of mycotoxins are removed during dehulling. Previous Food Standards Agency surveys of fusarium mycotoxins in retail oat products have identified that exposure to these toxins from oat products in the UK diet is very low.

Mycotoxins

Mycotoxins are toxic chemicals produced by specific fungi that can grow on a variety of different crops and foodstuffs. Different fungal species produce mycotoxins of widely varying toxicity to humans and animals. Fusarium species are not the only group of fungi to produce mycotoxins, they are also produced by ergot alkaloids and ochratoxin A (the latter during crop storage). *F. avenaceum*, *F. culmorum* and *F. graminearum* are the main mycotoxin-producing species, and these all produce similar symptoms. *F. poae* and *F. langsethiae* do produce mycotoxins but are not such an important source. *M. nivale* and *M. majus* do not produce mycotoxins. Mycotoxins formed before harvest are stable and likely to remain during storage but not increase.

Legal limits

Although legal limits exist for fusarium mycotoxins in UK cereals, the risk of exceeding them is low. Risk varies between regions and years depending on climate and the intensity of host crops in the region. Levels of mycotoxins are much lower in the UK than in mainland Europe and rarely exceed current EU limits.

DON and ZON

There are legal limits for fusarium mycotoxins deoxynivalenol (DON) and zearalenone (ZON) in wheat, barley, and oats intended for human consumption and guidance limits for grain for feed. The owner (farmer, merchant or processor) is legally obliged to ensure the grain is safe for human consumption. This means that all sellers must be able to demonstrate due diligence in determining the levels of mycotoxins that are present. Depending on end use, processors may require a lower limit at intake than the legal limit for unprocessed cereals to ensure finished products conform to legal limits.

T-2 and HT-2

T-2 and HT-2 mycotoxins are produced by fusarium species that are favoured by drier conditions, such as *F. langsethiae*. Therefore, risk factors are different to those for DON/ZON. Currently (2019), there are no legal limits for T-2 and HT-2. In 2013, the European Commission published a Recommendation that included indicative levels for the combined concentration of T-2 and HT-2. The Recommendation states that Member States, in conjunction with industry, should continue to monitor these mycotoxins and, where they exceed the indicative level, conduct investigations to determine why the exceedances occurred and what mitigation can be used to avoid exceedances occurring in the future.

End-use	DON	ZON
Unprocessed wheat and barley (L)	1,250	100
Unprocessed oats (L)	1,750	100
Flour (L)	750	75
Finished products (L)	500	50
Infant food (L)	200	20
Feed grains (G)	8,000	2,000
Complete feedstuffs for pigs (G)	900	250
Complete feedstuffs for piglets and gilts (G)	900	100
Complete feedstuffs for calves, lambs and kids (G)	2,000	500

Table 1. Limits for mycotoxins (ppb) in grain.

End-use	HT-2 and T-2
Unprocessed wheat (I)	100
Unprocessed barley (I)	200
Unprocessed oats with husk (I)	1,000

Table 2. EU indicative levels (I) for the combined concentration of HT-2 and t-2 (ppb) in unprocessed cereals

Definitions

- Legal limits – maximum levels for specific mycotoxins in cereals and cereal products, as defined by European Commission regulations and applied at the point of sale
- Guideline limits – guidance as to the acceptability of feed and feedstuffs
- Indicative levels – guidance on when to investigate high levels to identify mitigating actions

Management

The risk of fusarium diseases can be minimised throughout the season: from rotation planning, to deciding which field to harvest first.

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WORKING TOWARDS A REGEN AG DEFINITION

Written by L. Schreefel, R.P.O. Schulte, I.J.M. de Boer, A. Pas Schrijver, H.H.E. van Zanten

Published as "Regenerative agriculture – the soil is the base" in Global Food Security 26. Follow QR Code to read full article with references. Abridged for publication here.

Summary

Regenerative agriculture (RA) is proposed as a solution towards sustainable food systems. A variety of actors perceive RA differently, and a clear scientific definition is lacking. They reviewed 28 studies to find convergence and divergence between objectives and activities that define RA. Their results show convergence related to objectives that enhance the environment and stress the importance of socio-economic dimensions that contribute to food security. The objectives of RA in relation to socio-economic dimensions, however, are general and lack a framework for implementation. From the analysis, they propose a provisional definition of RA as an approach to farming that uses soil conservation as the entry point to regenerate and contribute to multiple ecosystem services.

1. Introduction

The global food system currently releases about 25% of annual anthropogenic greenhouse gas (GHG) emissions, causes about one-third of terrestrial acidification and is responsible for the majority of global eutrophication of surface waters. If our food system continues with current practices, using synthetic pesticides, artificial fertilizers, fossil fuels and producing food waste, the carrying capacity of the planet is likely to be surpassed. Therefore, the key challenge for humanity is to produce enough safe and nutritious food for a growing and wealthier population within the carrying capacity of the planet.

The importance of producing food within the carrying capacity of the planet is also increasingly acknowledged in policies - for example,

the EU Circular Economy Action Plan, the Paris Climate Agreement and the Common Agricultural Policy. This challenge has led to new narratives for sustainable agriculture. Some of these narratives are production-oriented and find their solutions in approaches such as sustainable intensification, which explores increased production yields to reduce the environmental impact.

Another narrative argues that the production-oriented approach is not sufficient to deal with the key challenge for humanity and that consumption patterns should be adjusted for the global food system to function within the boundaries of our planet. Building on both the production and consumption-oriented approaches for example Van Zanten et al. (2018) argues that production and consumption-oriented approaches are needed together and should be in balance with their ecological environment. Their narrative takes a food systems perspective and aims at safeguarding natural resources by closing of nutrients and carbon cycles in the food system as far as possible, also referred to as a circular food system. Farming approaches within these narratives often share similar desires to reach an objective, such as achieve global food security, reduced use of external inputs and reduced environmental damage.

Some of these farming approaches have definitions that are comprehensively described in the scientific literature and regulated, for example, organic agriculture, climate-smart agriculture and sustainable intensification, while others remain yet as theoretical and mainly scientific concepts such as circular agriculture. An approach that recently gained attention in the literature

as a solution for a sustainable food system is regenerative agriculture (RA). Currently, RA does not have a comprehensively described scientific definition. In absence of such a scientific definition, a variety of researchers may foster diverging perceptions of RA. For example, Malik and Verma (2014) describe RA as dynamically advanced modified technique involving the use of organic farming methods, while Elevitch et al. (2018) describe RA as a farming approach that has the capacity for self-renewal and resiliency, contributes to soil health, increases water percolation and retention, enhances and conserves biodiversity, and sequesters carbon. Therefore, in this review, we assess the background and core themes of RA by examining the convergence and divergence between definitions in peer-reviewed articles. An assessment of the background and core themes of RA allows the establishment of an evidence-based provisional definition. Such a definition forms a basis for further discussion not only within science but also among a large group of actors (e.g. governmental agencies, sector organisations, industries and farmers).

This large group of actors may foster different definitions dependent on their particular interests. A provisional definition is, therefore, essential to establish a common definition in which more views are included and indicators that enables actors to assess their performance towards a sustainable food system. Indicators, for example, enables governments and industries to monitor their performance towards the Sustainable Development Goals (SDG's), it enables policymakers to create supporting policies for actors in the field, it enables researchers to have a scientific basis to accumulate



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knowledge and it enables farmers to assess which activities to adjust. To illustrate the convergence between sustainable farming approaches we relate RA to organic agriculture as an example of a regulated farming approach and circular agriculture which remains yet a theoretical concept.

2. Materials and methods

We systematically studied peer-reviewed articles to find definitions of RA using the methodological framework PRISMA-P (Preferred Reporting Items for Systematic Reviews. Five journal databases were searched for definitions of RA in December 2019. Keywords used to create a search string to find articles that include a definition for RA build upon the words 'regenerative' and 'farming' (see supplementary materials B10).

For 'farming' different synonyms were used, including agriculture, agronomy and food system. Search terms such as 'agronomy' and 'food system' were included to capture definitions for RA embedded in the transition towards a regenerative food system. The database search yielded 279 articles mentioning 'regenerative' and 'farming' (see Fig. 1).

These 279 articles were screened on their abstract and titles and narrowed down to 43 articles. The eligibility

criteria to narrow down articles based on their titles and abstracts were to exclude: duplicates, unavailable articles within the selected databases, articles which were not peer-reviewed and articles unrelated to agriculture. After excluding fifteen articles which did not contain a definition of RA, 28 articles remained for further synthesis.

The following four aspects were analysed to determine the themes of RA: i) the number of articles referring to the themes, ii) the number of converging and diverging interpretations of nomenclature within themes, iii) the classifications of themes among objectives or activities and iv) the relation of themes with the three dimensions of sustainability, i.e. people, planet and profit. Converging themes indicate that authors of different articles present similar objectives within their definitions. Diverging themes present contradictions or issues which are unclear. The triple bottom line approach (people, planet and profit) was used to categorize themes among social, environmental and economic aspects.

Furthermore, we analysed whether definitions were based on the objectives of researchers or farmers and to which scale (farm, regional or systems-level) they relate.

3. Results and analysis

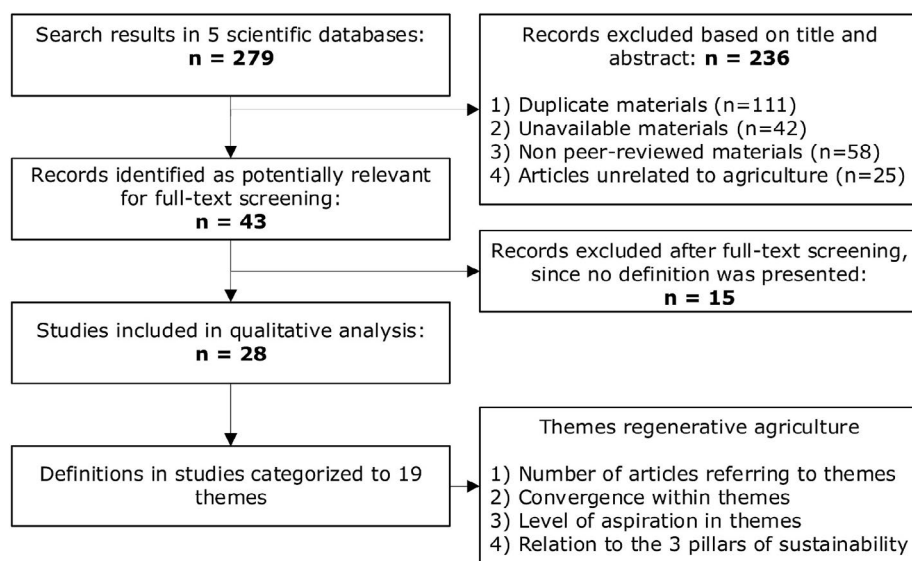


Fig. 1. Illustration of the research methodology to analyse existing definitions of regenerative agriculture, in which 'n' represents the number of search records.

3.1. The core themes of regenerative agriculture

In the 28 peer-reviewed articles we found that definitions addressed different issues (e.g. soil health, climate change) and scales (e.g. farm, food systems-level), resulting in different levels of implementation. Our review yielded 214 objectives and 77 activities. The assessment of the convergence among objectives and activities, which was based on the underlying issues, resulted in thirteen themes for objectives and seven themes for activities (Fig. 2). These twenty themes referred mostly to the environmental dimension of sustainability (seventeen out of nineteen). Environmental issues were addressed from farm to food systems-levels (Fig. 2). Of these, all activities and four objectives specifically focussed on soil issues: enhance and improve soil health, improve soil carbon, improve soil physical quality and improve (soil) biodiversity. The multiple aggregation levels and quantity of articles referring to environmental issues indicated that RA focusses specifically on environmental issues, and in particular soil issues. We will first discuss the environmental themes that show most convergence among definitions followed by themes with divergence.

3.2. Themes in RA showing convergence

All reviewed articles related RA with the environment (planet) and mainly with improving environmental issues, which is referred to as regenerate the system, reduce environmental externalities and improve the ecosystem. Convergent objectives were mentioned regarding reducing environmental externalities e.g. 'reduce environmental damage' and 'reduce environmental pollution'. Similarly, there was convergence about the improvement of the ecosystem. A healthy agroecosystem was referred to as a resilient ecosystem that enables the provision of ecosystems services, such as provisioning, regulating, habitat and supporting services.

These three environmental themes were further articulated by four themes that refer to the improvement of the food system: enhance and improve soil health (n = 15), optimize resource

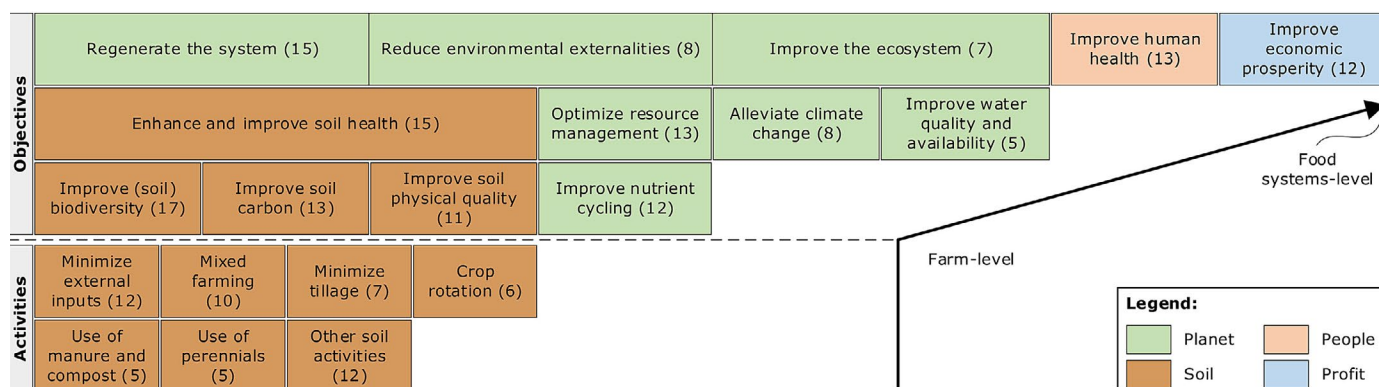


Fig. 2. The core themes of regenerative agriculture, in which 'the number between brackets' represents the number of search records.

management (n = 13), alleviate climate change (n = 8) and improve water quality and availability (n = 5). The theme enhance and improve soil health received most attention; seventeen of 28 articles explicitly mentioned improving soil quality in a variety of synonymous objectives, such as 'improve soil quality', 'contribute to soil fertility', 'enhance soil health' and 'improve their soils' (White and Andrew, 2019, P.2). A synthesis of the issues among the objective to improve

soil quality is that a healthy soil is the basis for RA and therefore degraded agricultural soils should be restored to healthy soils. This is expressed by, for example, Rhodes (2012, P.380) who mentioned that RA 'regenerates the soil' and by Diop (1999, P.296) who mentioned that RA 'gives the soil as a resource the first priority'. Thirteen out of 28 studies mentioned objectives to optimize resource

management. Reviewed articles

highlight objectives towards recusing waste and optimal nutrient availability. They indicated RA as a system which has the objective to regenerate resources in an integrated manner for sustained soil fertility and desired crop and animal productivity. They mentioned, for example, issues as 'minimize waste', 'synergisms in different combinations and methods of management', 'regeneration of natural resources', 'improve nutrient retention and availability' and 'encompass solid-

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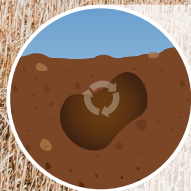
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waste management'. Themes alleviate climate change and improve water quality and availability received less attention compared to other themes with objectives. Moreover, eight of 28 articles have the objective to alleviate climate change. Studies mentioned for example to 'reduce GHG emissions', 'invert carbon emissions of our current agriculture' and 'mitigate climate change'.

Similarly, five of the 28 studies mentioned issues supporting the theme of improve water quality and availability. For example, to 'improve water quality', 'achieve clean and safe water runoff', 'reduce water shortages' and 'protect freshwater supply'. Other studies did not mention such objectives about the alleviation of climate change or the improvement of water quality and availability. The objectives enhance and improve soil health that received most attention were further articulated by more specific objectives which include improve (soil) biodiversity (n = 17), improvement of soil carbon (n = 13) and soil physical quality (n = 11). An objective frequently mentioned (13 out of 28) is to improve (soil) biodiversity for improved soil functioning, which relates to above and below ground biodiversity.

The issues among this theme showed convergence, although different issues are mentioned in the reviewed articles: the improvement of soil biodiversity by 'promoting soil biology' or more general statements such as 'increase the biodiversity'. Although biodiversity is clearly an important theme, it remains unspecified what is meant with the improvement of biodiversity (below or above-ground biodiversity, to which scale does it relate). Most studies expect or assume, however, that RA will improve biodiversity, which in general is seen as a precondition for a sustainable food system. Another objective which shows convergence and is frequently mentioned (13 out of 28) is to improve soil carbon, articulated in the reviewed article as for example 'build soil organic matter'. The improvement of soil carbon is considered a cross-cutting issue across the three spheres of soil science (soil chemistry, soil physics and soil biology)

since it affects all three aspects.

Improving soil carbon levels affects, for example, soil structure and porosity; water infiltration rate and moisture holding capacity of soils; biodiversity and activity of soil organisms; and plant nutrient availability. The last objective related to enhance and improve soil health is to improve soil physical quality. Similarly, to the previous theme, eleven of 28 articles mentioned improving soil physical characteristics and reducing threats to soil quality. Examples of improvements in soil physical characteristics include 'improvement of water infiltration', 'improvement of water holding capacity' and 'improvement of soil aeration'. Mitigation of soil threats included 'minimizing erosion', 'improving soil structure' and 'reducing soil degradation'.

An underlying theme of optimize resource management is to improve nutrient cycling. Twelve out of 28 articles mentioned convergent issues regarding nutrient cycling and these articles share the ambition to work towards closed nutrient loops. Examples are 'improve nutrient cycling', 'tendencies towards closed nutrient loops' and 'more on-farm recycling'. In addition to objectives, most of the reviewed articles (20 of 28) also mentioned activities to define RA (Fig. 2). Activities showing convergence in the literature are for example minimizing external inputs, minimizing tillage, using mixed farming, improving crop rotations, and using manure and compost. These activities direct towards a food system that builds on its ecological cycles and as a co-benefit reduces environmental externalities.

The suggested activities promote the integration of crop-livestock operations, in which animals are primarily valued for their capabilities to build soil, besides their role in producing food and fibre. Livestock breeds are, therefore, chosen for their compatibility with their local environment. The suggested activities also shift from single to multi-cropping systems, in which the use of perennials is favoured over annuals, because perennials have more extensive and deeper root systems and don't leave

fields fallow in between growing seasons.

Therefore, perennials are more resilient to weather extremes, reduce soil erosion, reduce nutrient runoff, improve water conservation and carbon sequestration. Relying on ecological cycles also resulted in a preference for animal manures over artificial fertilizers, and for the use of natural pest control over synthetic pesticides. Minimizing tillage is a specific crop management technique valued to reduce soil disturbance, due to the absence of heavy tillage machinery, allowing earthworms to aerate the soil and increase nutrient distribution.

Activities among the theme 'other soil conservation practices' did not necessarily represent divergence, however they presented various activities that were not clustered as a separate theme, such as the use of windbreaks, silvopasture, and managed grazing. These activities are in line with the objectives of RA, without being clustered into separate themes.

3.3. Themes in RA showing divergence

Although the reviewed articles may show convergence upon most of the themes, we can discern three themes showing a degree of divergence: regenerate the system, improve human health and improve economic prosperity. These themes show divergence because they embrace a sum of issues which do not meet the requirement of at least five convergent issues to form a separate theme. One of the key objectives of RA is that it is part of a regenerative system. A large number of articles (15 out of 28) referred to environmental objectives regarding the theme regenerate the system. A total of fourteen environmental objectives showed that RA is aimed towards productive agriculture that focusses on the health of nature through the regeneration of the resources the system requires (e.g. energy, water, nutrients and carbon). The objectives within this theme remain rather vague because the reviewed articles did not define what is meant by objectives such as RA: should be able to 'restore

earth', 'regenerates the natural system' and creates a 'long-term rehabilitative strategy'. Such objectives may require a more elaborate description of, for example, the capture of socio-economic aspects and how such objectives can be implemented. The theme improve human health relates to the objectives to provide goods and services for human health to ensure global food security through RA. The quantity of studies (13 out of 28) mentioning social issues is large, however, no themes could be formed with lower levels of aggregation due to a lack of studies mentioning convergent issues. This theme, therefore, showed high variability between issues. A total number of 27 issues was related to this theme and based on the issues we can express that RA aims for sustainable food production which should be in balance with both environmental and social issues. The reviewed articles highlight the quality of human life emphasizing the need to invest in 'regenerating the social system', 'restoring human health', 'interspecies equity', 'social justice', 'regenerating farm families', 'supporting local populations', 'sustainable food supply' and 'reducing food shortages'. Other issues mentioned were fitting social costs, 'improvements in animal welfare', 'cultural re-appreciation' and 'social diversity, with a variety of knowledge and diverse economies'.

This theme presents different issues in which we can discriminate human health and wellbeing issues relating to different scales (e.g. farm families, local populations). For example, some articles mentioned human health issues (e.g. physical conditions) and other human wellbeing issues (e.g. happiness of the farmer). An issue which is recognized by only one author is that RA values spirituality in their holistic approach of farming. The theme of improve economic prosperity refers to the economic sustainability of farmers: twelve out of 28 studies mentioned a total number of fifteen issues regarding economic prosperity. Issues among this theme showed some divergence but lacked operationalisation. Studies presenting economic issues mentioned that regenerative agriculture creates e.g. 'long-term economic sustainability', 'improves crop yields', 'improves soil productivity' and 'political-economic repositioning'. Although these issues present various diverging objectives, they all reflect that regenerative economics work towards a sustained farm income providing goods and services that contribute to human well-being and global food security. From the objectives within this theme, it remains unclear what activities are involved to reach for example long-term economic sustainability.

4. General discussion

This study is the first to systematically review the background and core themes of RA based on peer-reviewed articles. Analysis of the 28 included articles showed that there is currently no uniform scientific definition. Instead, multiple combinations and variations of objectives and activities together define RA. The



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convergence within these definitions resulted in the core themes of RA. These core themes are compatible with the ecosystem services described by TEEB (2010).

Themes such as enhance and improve soil health, optimize resource management, alleviate climate change and water quality and availability are contributing to multiple provisioning and regulating ecosystem services. These provisioning and regulating ecosystem services described by TEEB (2010) contribute to food security and relate to the core themes of RA by for example regulating climate, soil erosion and water purification to provide i.e. food, feed and fuel. Themes such as improve soil physical quality and improve nutrient cycling are aspects that come back as supporting ecosystem services.

The socio-economic dimension we found in RA, improve human health and improve economic prosperity relates, furthermore, to some components of cultural ecosystems services. From our review we, therefore, propose a provisional definition in which RA is defined as: an approach to farming that uses soil conservation as the entry point to regenerate and contribute to multiple provisioning, regulating and supporting ecosystem services, with the objective that this will enhance not only the environmental, but also the social and economic dimensions of sustainable food production.

We acknowledge that RA is a rapidly evolving farming approach in which more views and studies could allow further refinement of the proposed definition. Although for example, Diop (1999) and LaCanne and Lundgren

(2018) based their study on farmers perception in relation to RA, we used peer-reviewed articles including opinion, review and research articles mainly focusing on environmental aspects of RA. These peer-reviewed articles articulated insights of natural scientists rather than other actors such as farmers and policy makers. Related to this description, we will further discuss 1) the core themes of RA, 2) the relation of RA with circular and organic agriculture to show their convergence and 3) the next step in fostering the transition towards RA.

i) The core themes of RA

In this study we reviewed 28 peer-reviewed articles which enabled us to describe themes that together characterize RA. These peer-reviewed articles mentioned in general convergent objectives related to environmental themes such as resource management, water quality and availability, alleviate climate change, with a strong focus on improving soil quality (Fig. 2). This shows that the soil is the base of RA and that RA strongly focusses on the environmental dimension of sustainability. Although socio-economic objectives are mentioned in reviewed articles, the issues raised did not result in underlying themes (issues needed to be mentioned five times to become a theme). The themes are, however, sensitive to the amount of convergent issues appropriate to form a theme. From the sensitivity analysis, we learnt that, had we chosen three convergent issues to form a theme, then cultural diversity would have been underlying to the theme improve human health. In addition, eight other

themes could then have been formed as well, which include minimize waste underlying to optimize resource management; minimize erosion, improve water holding capacity and improve water infiltration underlying to improve soil physical quality; intercropping, the use of windbreaks, forest farming, riparian buffers, silvopasture and managed grazing in addition to minimize fertilizer and pesticide use among activities.

ii) The relation of RA with circular and organic agriculture

In order to illustrate the convergence between sustainable farming approaches, we relate the themes of RA to circular agriculture (CA) which remains yet a theoretical concept and organic agriculture (OA) as an example of a regulated farming approach. CA originates from a much broader concept than RA, the circular economy (CE) using the 4R-framework (reuse, repair, refurbish and recycle) as a base-line. CA uses the themes of industrial ecology as it promotes the circular utilization of agricultural resources and waste products. The entry point in CA is, therefore, to keep flows of mass and energy of products at their highest utility through a positive developing cycle. RA has a different entry point namely healthy soils and environmental issues which should be in balance with social values. While, RA and CA may have different entry points in their approaches, both rely strongly on the environmental dimension of sustainability, since they share similar objectives regarding e.g. reducing environmental externalities and optimizing resource management.

Nevertheless, RA also shows to



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relate to a social dimension. By contrast, it is unclear to which extent CA also relates to this social dimension, since the current reviewed articles about CA did not mentioned social issues within their definitions. The different entry points of RA and CA may lead to a different focus in their farming approach, in which CA focuses on topics such as avoidance of waste and the reuse of resources. Recently, this 4R framework from CE is translated to themes related to circularity in agricultural production – referred to as circular food systems. The themes of circular food systems go beyond agriculture production and also take into account consumption, therefore circular food systems work on a larger scale compared to RA and also includes issues such as reuse of by-products and feed-food competition. OA is an example of a farming approach that has a comprehensively described scientific definition and is regulated by different authorities worldwide, e.g. European Commission (2019) and USDA (2019).

The timeline of organic agriculture is described by Arbenz et al. (2016) in which OA started very similar to RA, with a pioneering phase (known as Organic 1.0). In this pioneering phase objectives were used to define OA as a farming approach that contribute to sustainable global food security while respecting all dimensions of sustainability. RA, as shown in this paper, is currently in this pioneering phase and the regenerative themes defined in this paper are to varying extents convergent with aspects mentioned in OA as IFOAM – Organics International (2019) focuses on the health of soils, ecosystems, people and their management which relies on ecological processes (e.g. nutrient cycling, biodiversity). The objectives in the pioneering phase, evolved into Organic 2.0 in which OA was regulated by certification of standards (Arbenz et al., 2016). These standards presented as a set of technical checklists (e.g. USDA, 2019), described mostly what 'not to do', for example, 'Do not use synthetic pesticides'. Synthetic pesticides are replaced by 'natural inputs' such as organic pesticides (zinc and copper oxide) which, however, still have a damaging effect on the environment (e.g. loss of biodiversity).

These standards, therefore, often fail to entirely capture the aspects that are at the core of the organic philosophy and it may be that some organic farmers are 'locked' into organic regulations to guarantee the delivery of products that conform to organic standards. The Organic 3.0 strategy recognizes this and aims to change this by becoming less prescriptive and more descriptive, working towards the replacement of the list of 'do's and don'ts', with a mode of outcome-based regulations which should continuously be adaptable to local contexts. This requires a systemic shift towards an integrative farming approach like RA. Such an integrative farming approach does not focus on individual (pre-decided) sustainable activities, but on improving ecological and social processes and observable outcomes which enable a larger solution

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space for implementing sustainable activities.

Some authors, therefore, mention that regenerative activities are organic, however, other reviewed articles showed that not all organic activities are regenerative for example the use of organic pesticides and raw minerals. Not all objectives of OA however are centre-stage in RA, with one difference being the objective to promote animal welfare. Improvement of animal welfare is mentioned in one peer-reviewed

article defining RA, although certification frameworks for RA such as Regenerative Organic Certification do put animal welfare centre-stage. As RA is currently in the pioneering phase, there is merit in building on the learnings from the evaluation of OA through the last hundred years, to avoid and leapfrog similar pitfalls that may arise.

iii) The next step in fostering the transition towards RA

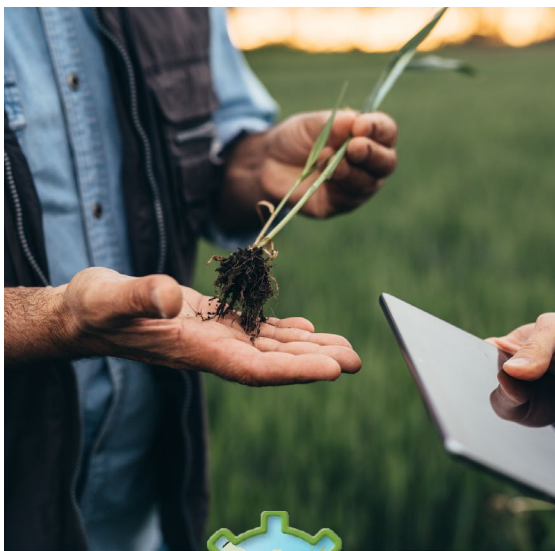
This review showed the core themes of RA from the many definitions that are presented in peer-reviewed articles. These core themes of RA, enable to define indicators to allow actors to regulate and control their activities to foster the transition towards RA. The reviewed articles do show indicators on some specific practices of RA, for example, Elevitch et al. (2018) provide regenerative agroforestry standards. They present a measure which should increase biodiversity throughout the life of the agroforest: at least eight plant families, genera, species, and/or varieties of woody perennials per 100 m². It is, however, unclear if this measure refers to each category (e.g. families, genera, species) individually or whether it refers to the sum of the individual categories. Furthermore, the applicability of these standards to other farming practices is limited. Based on the current reviewed articles we were therefore unable to identify specific indicators which allow for a generic assessment of RA. Other research, however, shows a wide range of indicators are already available for sustainability assessments (De Olde et al., 2016) which can be related to each of the themes underpinning RA. Having derived a clear provisional definition, our next step is to link these indicators to the themes of RA described in this paper, in order to facilitate a comprehensive assessment of RA and potentially refine the definition.

5. Conclusion

This review has systematically assessed definitions of RA in 28 peer-reviewed articles. Our analysis has shown that such definitions are based on several combinations and variations of recurring objectives and activities from scientists. The convergence within these definitions allowed us to formulate core themes of RA. Our findings show that RA focuses strongly on the environmental dimension of sustainability, which includes themes such as enhance and improve soil health, optimize resource management, alleviate climate change, improve nutrient cycling and water quality and availability, articulated by both objectives (e.g. improve soil quality) and activities (e.g. use perennials).

These themes enhance food security by contributing to provisioning (e.g. food, feed and fibre), regulating (e.g. climate regulation, soil erosion and water purification) and supporting (e.g. nutrient cycling and soil formation) ecosystem services. We also found a socio-economic dimension in RA, improve human health and improve economic prosperity, which relate to aspects of cultural ecosystem services.

This socio-economic dimension, however, relies currently on divergent objectives and lacks a framework for implementation. Therefore, we propose a provisional definition which defines RA as **an approach to farming that uses soil conservation as the entry point to regenerate and contribute to multiple provisioning, regulating and supporting services, with the objective that this will enhance not only the environmental, but also the social and economic dimensions of sustainable food production.** To foster the transition towards RA, this review contributes to establishing a uniform definition; subsequently, indicators and benchmarks should be created to assess RA.



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If you like Twitter, you will have seen many pictures of farmers reading their Direct Driller Magazines in nice or odd locations. They are a good thing to take away with you. But Julian Gold has set the bar high for the strangest location to read the magazine. While you are in the queue for the London Marathon!

If you read the last magazine, you will have read that Julian was running the London Marathon. Well, if you know Julian, then it won't be a surprise to hear that he smashed it and completed the course in 4 hours and 1 minute. He even managed to get some other runners involved in the regenerative agriculture movement!



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Recognising the demand for a linkage mounted drill with more output, Mzuri have developed the new Mzuri Pro-Til iGen.

Staying true to the Mzuri philosophy, the Pro-Til iGen is a one pass drill designed to produce the perfect seeding environment straight into stubble, cover crops and grassland. Accurate seeding depth is maintained across the width of the machine and dual reconsolidation is achieved through a full width packer and individual press wheels.

Aimed at farmers looking for a high output mounted solution, the new range has launched as 4.8m machine which Mzuri felt was the natural initial size to start the range. The 4.8m model features 15 coulters on a row spacing of 320mm.

Based on the Mzuri Pro-Til core concept, the Pro-Til iGen features a leading tine to prepare a nursery seedbed, dual reconsolidation, and independent coulters as standard. With independent coulters arguably Mzuri's most respected feature, it is no surprise the Pro-Til iGen boasts fully independent coulters, each with its own depth wheel which reconsolidates, but more importantly provides individual height control of each coulter. A simple mechanism is employed to control height and pressure of the rear seeding wheels, offering exceptional seed placement accuracy across the width of the machine.

Reliable seed delivery is achieved through twin metering units with seed being conveyed via a generous fan system. The iGen's 2200ltr tank is pressurised to effectively double output over conventional metering, with the drill operating comfortably at speeds up to 18kph.

The Pro-Til iGen is fitted with a twin harrow bar as standard to achieve a uniform level surface, ideal for getting the best out of pre-emergence herbicides.

Mzuri made the decision to expand their mounted offering to cater to a growing market of customers looking for a linkage format without compromising on reliable establishment or



Mzuri have recently launched the new Pro-Til iGen linkage machine to cater for customers looking for a high output mounted solution.

output. Customers can also benefit from the associated cost savings of a mounted machine, with the Pro-Til iGen range expected to be up to 30% cheaper per metre than its trailed version.

The new model is available to view at upcoming exhibitions including Groundswell and available to demo from this Autumn.

Specification	Pro-Til 480 iGen
Working Width	4.8m
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Hopper Capacity	2200 l
Row Spacing	320mm
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Format	Linkage



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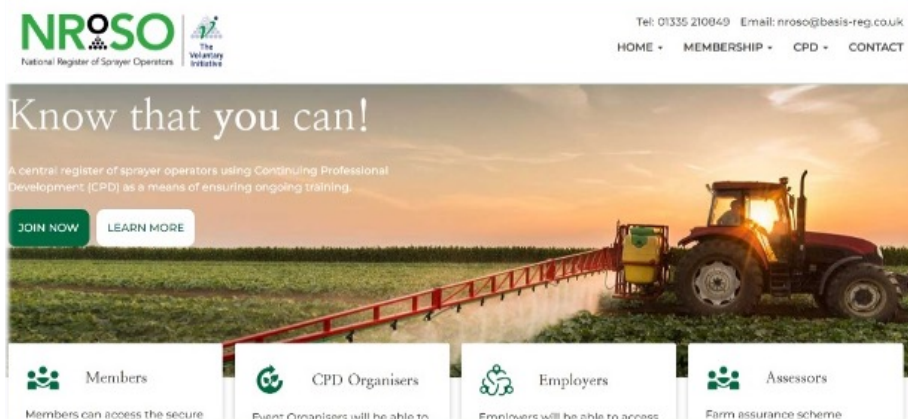
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NEWS FROM THE VOLUNTARY INITIATIVE

CHANGE OF ADMINISTRATOR FOR THE NATIONAL REGISTER OF SPRAYER OPERATORS (NROSO)

It has been a busy 12 months for the Voluntary Initiative, making arrangements to transfer The National Register of Sprayer Operators scheme to **BASiS** our new scheme operator. Andy Lister is the new NRoSO Membership Manager.

Andy gives an update on BASIS and how delivery of NRoSO will unfold over time. The new dedicated telephone helpline has greatly assisted over the past few months and keep your eyes peeled for the digital NRoSO newsletter.



The **NRoSO Advisory Board** has had a refresh and met with the new scheme operator to offer support and advice on sprayer operator professional development, the annual training event, knowledge trails at shows, integrated pest management and best application practice.

Work is underway for the 2023/2024 Annual Training Event; this will be a new format from BASIS and see improvements to the knowledge transfer and test procedure.

The VI and NRoSO will be exhibiting at Cereals 2023, Groundswell, Fruit Focus, CropTec 2023 and LAMMA 2024. Pop by the stand to claim NRoSO and BASiS CPD points.

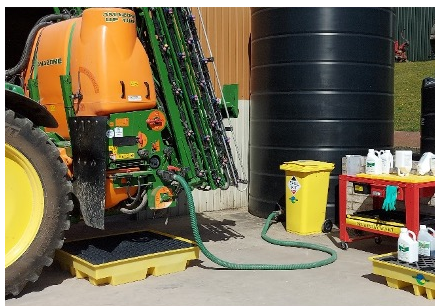
Pesticide enforcement officer visits to start October 2023

Please check with your agronomist that you're complying with your duties under plant protection product law. They may include confirmation of the registration submitted under the Official Controls (Plant Protection Products) Regulations 2020.

The role of a pesticide enforcement officer (PEO) is to conduct official controls on operators throughout the plant protection product (PPP) supply

chain in Great Britain (England, Scotland and Wales).

Operators include importers, manufacturers, formulators, those who package and label PPP's, distributors/



sellers and users of PPP's authorised for professional use.

The following links may be useful:

www.hse.gov.uk/pesticides/enforcement/peo-visit.htm

www.naac.co.uk/download/hse_publications/Storing-pesticides.pdf

https://voluntaryinitiative.org.uk/media/ie3j5hdj/bpg-pesticidestorage-6_small.pdf

Events – Water Protection

Through June and July, the Voluntary Initiative is organising a series of free events to highlight the need for careful stewardship to safeguard water.

Each of the Water Protection Days will include information on:

- Securing grants and funding for water protection.
- Current topics, filling and application & best practice.
- Combining food production and environmental protection.

Events will take place on mixed, arable and grassland farms and are open to anyone with an interest in water stewardship such as farmers, sprayer operators and agronomists.

Thursday 13th July 2023, The Grange, Mears Ashby, Northamptonshire – Arable, in collaboration with BASF. 10.00-15.00

We are also organising an autumn grassland event with United Utilities & a September webinar is in the pipeline.

Register for all events:

<https://voluntaryinitiative.org.uk/news-events/2023/arable-and-grassland-water-stewardship/>

BeeConnected

- is an online tool that does what it says on the tin, connects beekeepers with farmers and vice versa. It's free, quick and easy to use, and is designed to send anonymous notifications to surrounding beekeepers whenever you apply insecticide to your fields.

Developed in association with the NFU, BBKA (British Beekeepers Association) and CropLife UK, BeeConnected is funded and administered by the VI and currently connects more than 3000 beekeepers with nearly 2000 farmers.

For more info on The Voluntary Initiative, email us:

info@voluntaryinitiative.org.uk

MEGA BACTERIA!

Written by Steve Holloway

Soil microbes are tiny, often invisible to the naked eye. Organisms that play a crucial role in maintaining soil health and enhancing crop productivity.

These microscopic creatures are responsible for numerous functions, including nutrient cycling, decomposition, and the suppression of plant diseases. They also contribute to soil structure, water-holding capacity, and overall fertility.

Farmers who manage their soils with an eye towards promoting microbial activity, can benefit from improved crop yields, reduced need for chemical inputs and a more sustainable agricultural system.

Soil is alive - or at least it should be! Including bacteria, fungi, protozoa, to name just a few. Each plays a vital role in the soil's natural ecosystem

The life in the soil is essential to maintaining soil structure and its water-holding capacity. Promoting the growth of healthy plants, which, in turn prevents soil erosion and builds soil resilience to environmental stresses.

Soil microbes can perform a range of critical functions; they decompose organic matter and release essential nutrients such as Nitrogen, Phosphorus, Potassium; control soil-

borne pathogens and help maintain soil structure, and aeration.

Microbes are also important in plant growth and development, helping to regulate hormone levels and promote root growth, interacting with each other, the crop and soil in complex and diverse ways, determining the health of the soil.

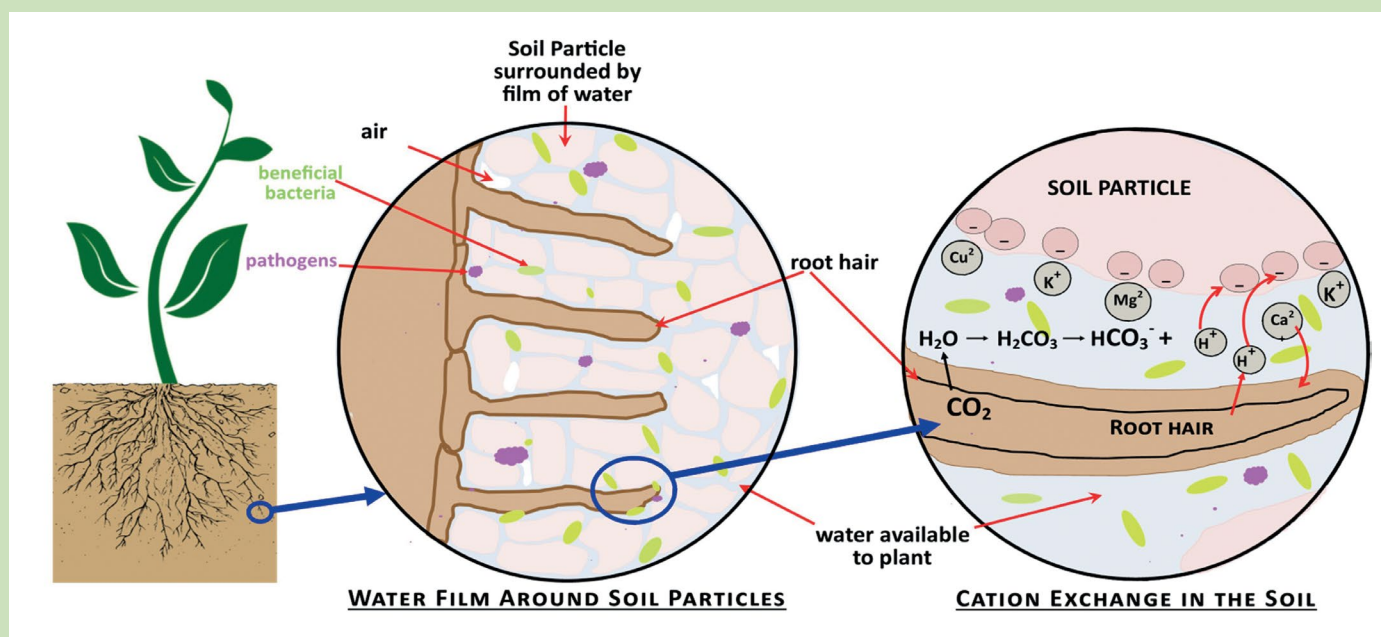
Some microbes form symbiotic relationships, mutually benefitting each other, while others participate in competitive interactions, competing for resources. These complicated interactions create a diverse soil ecosystem that supports healthier plant growth and soil fertility.

Changes in their environment both good and bad such as soil pH, temperature, and moisture content, can influence the living soil entities, leading to imbalances.

Studies have shown that soil life helps to protect plants from disease and environmental stress, which makes them essential for sustainable agriculture.

Probably the most notable is Mycorrhizal fungi; these form a symbiotic relationship with plant roots, as mentioned previously, enhancing nutrient uptake whilst rhizobia bacteria form nodules on legume roots, where they fix Nitrogen, making it available to the plant; however, although some soil microbes are natural plant defenders, plant pathogens can harm crops and reduce yield.

Today, farmers can easily promote soil microbial health by adopting some cultural practices that enhance soil biodiversity. These include varied crop rotation, which maximises root exploration of the soil, reduced tillage, and cover cropping. This mimics a



more natural system, all of which facilitate the building of soil organic matter and reduce soil-borne disease.

The bacterial role in soil water retention, is to enhance soil structure by producing polysaccharides, which hold soil particles together, resulting in increased water-holding capacity, so reducing the need for irrigating crops and providing a natural buffer.

These 'Mega-bacteria' do what they do best enabling farmers to reduce their reliance on synthetic fertilisers and pesticides by aiding the natural release of nutrients in a form that plants can easily absorb and use.

Imagine that you are a plant, all you want to do is grow thrive and survive and that takes energy; you don't want to waste your resources trying to transform your food into something you can eat. To continue the analogy... when you or I are hungry and fancy some soup, imagine the microbes have already picked the vegetables and blended them up for you ready to eat.

Similarly, certain microbial species can act as natural pest controllers, against harmful insects and pathogens. As previously mentioned, a plant's natural defences will require maintenance, so the crop must sacrifice resources etc. With an in-built army to protect them, plants can focus on what's important.

Increasingly over the past few years farmers have begun to use biological inoculants and alternative methods and products much more.

Microbial inoculants do offer numerous benefits - improving yields, reducing chemical reliance, enhancing soil health; however, their effectiveness can be variable depending on outside factors such as soil conditions, crop type, and Management practices.

Continuing research has identified specific bacterial strains and their

traits, meaning that growers can, with confidence, replace synthetic inputs in exchange for a natural equivalent. For example, it is no surprise that we still see crops testing short of Potash when many soils already have an overabundance of Potassium which is simply unavailable to the growing crop. The conventional solution of putting more K on seems crazy, when you think that there's already a microbe that can free- up the existing supply that is locked-up.

Bacteria can navigate to and release elements not accessible to crop roots including NPK; knowing and utilising the correct 'elemental liberator' can be key to saving £££ when compared to ineffective synthetic inputs.

Many have heard of the popular microbe Bacillus Subtillus; these rod-shaped bacteria can tolerate extreme temperatures and are extremely effective in combatting Take-all, Fusarium, and Club root, whilst acting as a soil and nutrient improver.

Often these microbes are put directly into the sprayer in a powder form resembling talcum powder, or perhaps you are brewing your own and making a form of microbial tea and applying them that way. However, Soil Fertility Services prefer to select the various strains subject to the job at hand, cultivate them and then return them to a spore form (put them to sleep), that way they remain more reliably stable for storage.

Once applied the microbial workforce awakens, setting about the task at hand; however, to continue to thrive survive and multiply, they will need to eat, which could be organic matter or sugars from plant root exudates, the latter of which may take some time.

Far better to provide the food source at the time of application and send

the army to work with a lunch box. SFS prefer a mix that also contains trace elements and carbon foods that support better microbial development.

While Bacterial Management offers substantial benefits, there are several challenges and limitations, such as selecting the appropriate product, ensuring proper application and monitoring its effectiveness.

Despite the significant advances in soil microbial ecology, there is still much that is unknown about the complex interactions between soil microbes and their environment. This lack of understanding can make it challenging to predict the effectiveness of microbial management techniques.

Over the last 25 years Soil Fertility Services have seen the tide shift as attitudes and understandings change. We all know of a farmer that got on well one season with a product while the neighbour who did exactly the same saw little change.

As an industry, we are slowly realising that no two ecosystems are the same and should be respected accordingly. As we continue to learn more about the role of soil microbes in agriculture, there is great potential for the development of new strategies and technologies for managing soil microbial communities; all hold promise for a more sustainable and productive agricultural system in the future.

If you want to see biological farming in action, why not give SFS a call to see what can be done biologically and equally to the point of what does NOT need to be done.

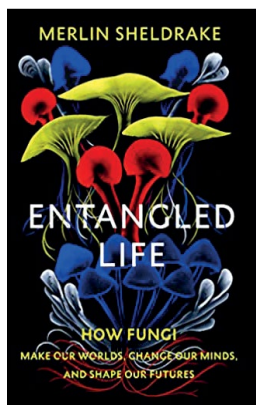


Steve Holloway

WHAT DO YOU READ?

If you are like us, then you don't know where to start when it comes to other reading apart from farming magazines. However, there is so much information out there that can help us understand our businesses, farm better and understand the position of non-farmers.

We have listed a few more books you might find interesting, challenge the way you currently think and help you farm better.



Entangled Life: How Fungi Make Our Worlds, Change Our Minds and Shape Our Futures

The more we learn about fungi, the less makes sense without them.

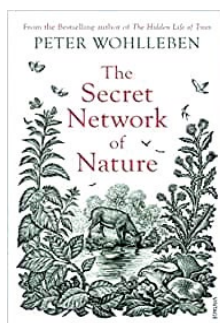
Neither plant nor animal, they are found throughout the earth, the air and our bodies. They can be microscopic, yet also account for the largest organisms ever recorded. They enabled the first life on land, can survive unprotected in space and thrive amidst nuclear radiation. In fact, nearly all life relies in some way on fungi.

These endlessly surprising organisms have no brain but can solve problems and manipulate animal behaviour with devastating precision. In giving us bread, alcohol and life-saving medicines, fungi have shaped human history, and their psychedelic properties have recently been shown to alleviate a number of mental illnesses. Their ability to digest plastic, explosives, pesticides and crude oil is being harnessed in break-through technologies, and the discovery that they connect plants in underground networks, the 'Wood Wide Web', is transforming the way we understand ecosystems. Yet over ninety percent of their species remain undocumented.

Entangled Life is a mind-altering journey into a spectacular and neglected world, and shows that fungi provide a key to understanding both the planet on which we live, and life itself.

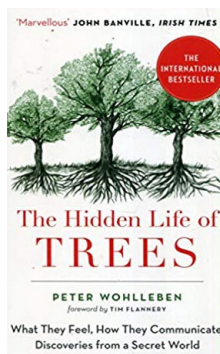
The Secret Network of Nature: The Delicate Balance of All Living Things

The natural world is a web of intricate



connections, many of which go unnoticed by humans. But it is these connections that maintain nature's finely balanced equilibrium.

Drawing on the latest scientific discoveries and decades of experience as a forester, Peter Wohlleben shows us how different animals, plants, rivers, rocks and weather systems cooperate, and what's at stake when these delicate systems are unbalanced.



The Hidden Life of Trees: What They Feel, How They Communicate

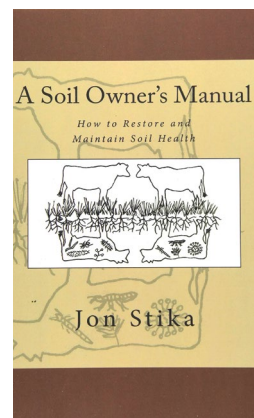
Are trees social beings? How do trees live? Do they feel pain or have awareness of their surroundings?

In The Hidden Life of Trees Peter Wohlleben makes the case that the forest is a social network. He draws on groundbreaking scientific discoveries to describe how trees are like human families: tree parents live together with their children, communicate with them, support them as they grow, share nutrients with those who are sick or struggling, and even warn each other of impending dangers. Wohlleben also shares his deep love of woods and forests, explaining the amazing processes of life, death and regeneration he has observed in his woodland.

A walk in the woods will never be the same again.

A Soil Owner's Manual: How to Restore and Maintain Soil Health

A Soil Owner's Manual: Restoring and Maintaining Soil Health, is about restoring the capacity of your soil to



perform all the functions it was intended to perform. This book is not another fanciful guide on how to continuously manipulate and amend your soil to try and keep it productive.

This book will change the way you think about and manage your soil. It may even change your life. If you are interested in solving the problem of dysfunctional soil and successfully addressing the symptoms of soil erosion, water runoff, nutrient deficiencies, compaction, soil crusting, weeds, insect pests, plant diseases, and water pollution, or simply wish to grow healthy vegetables in your family garden, then this book is for you. Soil health pioneer Jon Stika, describes in simple terms how you can bring your soil back to its full productive potential by understanding and applying the principles that built your soil in the first place. Understanding how the soil functions is critical to reducing the reliance on expensive inputs to maintain yields. Working with, instead of against, the processes that naturally govern the soil can increase profitability and restore the soil to health. Restoring soil health can proactively solve natural resource issues before regulations are imposed that will merely address the symptoms. This book will lead you through the basic biology and guiding principles that will allow you to assess and restore your soil. It is part of a movement currently underway in agriculture that is working to restore what has been lost. A Soil Owner's Manual: Restoring and Maintaining Soil Health will give you the opportunity to be part of this movement. Restoring soil health is restoring hope in the future of agriculture, from large farm fields and pastures, down to your own vegetable or flower garden.

DIRECT DRILLER PATRONS

Thank you to those who has signed up to be a Direct Driller Patron after the last issue. Our farmer writers are now rewarded for sharing their hard-earned knowledge and our readers have the facility to place a value upon that. The Direct Driller Patron programme gives readers the opportunity to “pay it forward” and place a value on what they get from the magazine. But only once they feel they have learned something valuable.

We urge everyone reading to consider how much value you have gained from the information in the magazine. Has it saved you money? Inspired you to try something different? Entertained you? Helped you understand or solve a problem? If the answer is “Yes”, please become a patron so that we can attract more new readers to the magazine and they can in turn learn without any barriers to knowledge.

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Clive and the rest of the Direct Driller team

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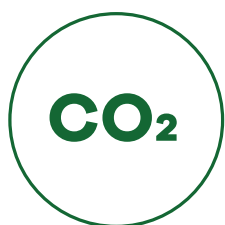
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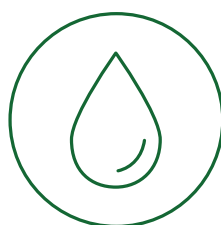
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