

ISSUE 4 | JANUARY 2019

DIRECT DRILLER

MAGAZINE

THE FUTURE OF YOUR SOILS

Do you COMPOST?

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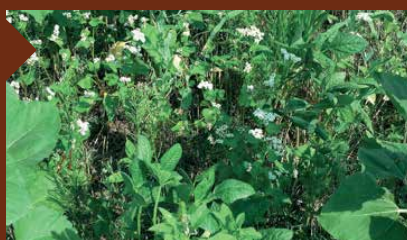
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DIRECT DRILLER

MAGAZINE

Issue 4
January 2019

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INTRODUCTIONS

MIKE DONOVAN

Homo sapiens are hard-wired to be critical and suspicious of the unknown. We apply the maxim 'if it ain't broke, don't fix it' where we can, and look for excuses to maintain the status quo. It applies to farming methods. The big gaps in no-till knowledge slow the progress of those who are direct drilling. They provide our conventional cousins the excuse to continue as they are. It would be good to have the knowledge gaps filled and this is where this magazine is playing a huge part, and it can do this because it's created and produced by enthusiasts who not only suck up knowledge but generate it as well. They join with similar minded farmers, and they allow all other farmers to join in. How good is that.

Looking on are those who find change difficult; advisors who are out of their comfort zone; Big-Ag which thought it could hold back the tide and continue selling bigger kit,

more complex chemistry, advanced genetics; politicians and government who forget the adage about empty vessels and continue to listen to the loudest and most established voices.

Enthusiasts will always focus on the unknown and what needs to be researched, and we see this in no-till events. Yet it's easy to forget just how much we do know. Keeping soil undisturbed and covered; using plant diversity to 'mine' nutrients; remembering that chemicals can damage beneficial biology as well as provide protection, and how this offers huge benefits for farmers and food production. This knowledge is, and needs to be seen as fundamental. Something taught in primary school.

Direct drilling has come late on the farming scene in the UK - Frank Lessiter from Brookfield, Wisconsin started his magazine No-Till Farmer back in 1972. TCS - Techniques Culturelles Simplifiées - has been going 20 years under the guidance

of farmer Ferderic Thomas. Direct Driller is ending its first year. No-till puts people out of their comfort zone, threatens the status quo and the livelihoods that depend on it. It continues to need mavericks at every stage, and I would really like to hear from all out there!



A WARM WELCOME FOR DIRECT DRILLER MAGAZINE

Thank you so much to everyone who stopped by at our stand at Croptec in November. Direct Driller Magazine shared a stand with BASE and we were busy for the whole 2 days talking to farmers and getting their feedback. The new 100 page format introduced for Issue 3, means that there is lots of content in every quarterly issue now. We gave out over 300 copies of the magazine at the show and given the level of sign ups we have seen since, those who picked one up obviously enjoyed the read.

The challenge with any magazine is to produce something that farmers really want to read. That way the magazine grows an engaged audience of farmers who continue to learn something new from every issue. Of course, we are all at different stages of our learning, which means that any given article in the magazine will be more relevant to some than others. But overall it needs to offer a challenging read. I think being free for farmers in the UK also helps!

If you are enjoying the magazine, please do come and see us at LAMMA, we will be there both days.



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FARMER FOCUS

SIMON COWELL



I have been farming using zero-till and biological methods for fifteen years and making my own compost has always been an integral part of the system. There are lots of biological inoculants on the market but if your soil is not in a good enough condition to live and multiply, they will soon die out. On the other hand, if your soil is in the right condition, the desired microbes will most likely be there anyway.

What is unique to compost is that it is a way of applying the good biology in it's own, perfect environment. This means that even if the soil conditions are hostile, the good biology has somewhere to live while gradually reaching out and changing the soil from a safe base.

About twenty years ago there was a general dumping area on the farm where we used to tip odd loads of horse manure, wet bales, tree cuttings and anything that wasn't suitable to go on a bonfire but was what we now think of as compostable. Every year or so we would go and push it up with a loader bucket just to tidy up. We didn't have a muck spreader and there wasn't enough there to justify getting a contractor in, so it just gradually built up over about six or seven years.

In 2013 I started applying gypsum to my high magnesium soils for which my contractor used a spinning disc muck spreader. When he finished, I asked him

to get rid of the old muck heap onto the heaviest part of a neighbouring field; it covered about a third of the area at roughly 6 tons/acre. The following wheat crop grew much stronger on the compost applied area and ended up yielding at least a ton to the acre more than the rest of the field.

The next crop of rape established far better in this area and grew with more vigour, going on to yield twice as much as the rest. And so, my interest in compost had begun, and I've been trying to replicate that amazing result ever since. Digging down, it was obvious that a massive change had taken place, the soil was a much darker colour and the structure was aggregated and open, allowing water to pass freely down to the drains. Just walking across the field, it was easy to tell where the dividing line was by the change in wetness and stickiness under foot. (Photo of rape crop) What is even more amazing is that the line still shows up in the field to this day, in spite of me of the whole field have two more compost applications since the original. (Photo of barley 12 years later)

After doing some reading up on the effects of compost, I found out that soil aggregation is created by the life in the soil, gluing particles together and leaving pore spaces between, where water and air can pass freely up and down the soil profile. The more aggregation you

have, the more the air in the soil can be refreshed, and so this enhanced oxygen availability stimulates the aerobic soil life to grow and reproduce at an ever-increasing rate.

Because of the relatively low application rate of compost, I soon realised that this was not a fertilisation effect but was actually a biological inoculation. I now treat compost making as a breeding operation; the original ingredients are the food which should have a carbon to nitrogen ratio equivalent to the microbes that are going to eat it, roughly 30:1, and with as many different ingredients as possible to bring a wide variety of bacteria, fungi and all soil life.

After turning manure from our own stables with a loader, which was very slow, I was lucky to find a second hand, tractor driven windrow turner for sale at a knock down price and was then able to start composting on a bigger scale.

The only livestock in this area in any quantity are horses, so they are my only option as a supply of manure. There are two riding school/livery yards nearby that need to get rid of their waste and they pay a contractor to deliver it into me. I get the trailers to tip in a straight line in the field where the compost will eventually be spread, away from ditches and drains. The line, or windrow as it is called, then needs tidying up with a





means checking the temperature every day and turning whenever it gets to 65. The first turn breaks up everything and thoroughly mixes the carbon and nitrogen components together, causing the decomposing bacteria to go crazy, which means that if the moisture and C:N ratio are right, 70C can be reached after one day. In practice I often have to turn every day for four days, then leave a one day gap, then three days, then turn once a week until it stops heating and the temperature stabilises.

The turner is quite aggressive, which it has to be to shred all the ingredients and get a thorough mix, but this does not help fungi and larger soil life to grow and multiply, so to get the maximum diversity, it needs to be left to mature for as long as possible, preferably up to a year.

The usual application rate is about four tons to the acre, which I see as just a biological inoculation. This rate

loader to get it within the four meter width of the turner. Four metres is the optimum width for a turner; a wider windrow would be too big because the centre is too far from the outside and soon becomes anaerobic, and anything narrower ends up having to be miles long to contain a decent tonnage.

It is a bit of a lottery what the ingredients are from these stables, sometimes there is a lot of wood shavings which makes it a bit high for carbon and also

too dry, but I just have to cope with however it comes. When there is not enough moisture for the microbes to get working, I leave it over winter and then start it again in the Spring. Manure from horses bedded on straw is the best because it always seems to hold enough urine for moisture and has the right C:N ratio.

When composting manure from our own stables I have more control over the ingredients and so can make it much better and biologically diverse. Local tree surgeons drop off wood chippings occasionally, a landscape maintenance company drops grass cuttings, and then there are plenty of leaves in the Autumn. I have used gypsum on my heavy, high magnesium soils for twenty years now, but I am not sure how good it is for the soil biology, so more recently I have

been adding it to the mix at the start so that it is incorporated into the compost and is applied in a biological form.

Inoculation can come from a sprinkling of previously made compost, but the last batch I made had some top soil mixed in.

The temperature of the air in the soil stays relatively stable, night and day, but above ground it goes from warmer in the day to colder at night. Since the cold night air is heavier than air in the soil, they swap places by small convection currents. This is the soil breathing every 24 hours, all year round, replacing the soil life's exhaled CO₂ with fresh oxygenated air. It always amuses me when people say they need to do a cultivation because they have to "get some air into the soil", whereas soil which hasn't been interfered with gets fresh air into it 365 times a year.

How to build a home built compost turner re-using a truck axle is featured in Practical Farm Ideas issue 22-2 <http://bit.ly/2IO8Qev>



Quite a lot of experts recommend a clay addition to give the finished product more body and give the nutrients something to hold onto, but I think the top soil is even better. It is the ultimate biological starter because it comes from a completely natural grassing marsh which grows plentiful grass without any artificial inputs; just what I want my arable fields to do. When finished, it had the same smell as the best, the most natural soil you could ever come across, proving that the grassland biology had been multiplied by the hot aerobic process.

From the first turn to being finished usually takes four or five weeks. The idea is to not let the temperature go above 70 degrees C because the useful soil life that we are trying to multiply can't live above that. This

is not enough to build organic matter levels, nor are there much in the way of nutrients in that amount. I can never make enough compost, so it is about getting it to cover as large an area as possible, hoping to get around the farm every four years. This year I have tried a field at two and a half tons, which is not easy with a big ten ton spreader, but now that my no-till land is billiard table flat, my contractor doesn't mind driving at fifteen or twenty miles per hour.

Having spent the last fifteen years making and trying to perfect the art of aerobic composting, my conclusion is that there are two things that determine the quality and effectiveness of the final product: diversity and maturity. Diversity means the biggest range of different species of bacteria, fungi etc. at the start, and maturity means how long the compost has been left so that the larger arthropods, protozoa and nematodes can develop and multiply.

SOIL CALCIUM AND SOIL HEALTH – THE CONNECTION?

By James Warne, Soil First Farming

I recently attended the appropriately entitled 'Calcium Conference' which served to remind me of the importance to distinguish between calcium and pH balance within our soils, and also the importance of calcium to the dairy cow. How easily we confuse the use of calcium has with the role of pH management within soils simply because we regularly test soil pH and then apply a calcium containing product to correct the pH.

So let me deal with this confusion. pH measures the concentration of hydrogen ions in the soil solution (when the pH is below 7) and adsorbed on the clay colloids (no mention of calcium there!) As the concentration of hydrogen ions in the soil solution rises exponentially the pH falls. For example as the pH drops from pH 6 – pH 5 the concentration of Hydrogen ions increases tenfold and if it drops from pH 6 – pH 4 the concentration of hydrogen ions increases by 100. To neutralise the hydrogen ions we most usually apply lime, or calcium carbonate in its various forms. The neutralising bit here is the carbonate, NOT the calcium. The carbonate disassociates from the calcium in the soil and reacts with the hydrogen to leave carbon dioxide and water while the calcium ion replaces the hydrogen in the soil solution and on the clay colloids. To get scientific for a moment the reaction is



Calcium carbonate in the soil reacts with the hydrogen ions (the acidity) to give calcium ions, carbon dioxide and water.

So if the calcium does not neutralise the acidity why should I be worried about my soil calcium levels?

Calcium is the sixth most abundant element in plants, and animals for that matter. It is also the third most abundant metal in the earth's crust. Historically it has always been assumed that there is generally enough calcium in the soil

to supply the crop requirements if the soil is limed to the correct pH. However we also lose calcium from the soil in large amounts every year by a variety of processes. Crop removal via mechanical or animal means removes varying amounts of calcium but these losses are quite small compared to losses caused by inorganic fertilisers and natural leaching.

Work done at Rothamsted has shown that considerable amounts of calcium are lost by leaching, and the amounts lost by leaching double with every unit increase in pH, see the table below.

Effect of pH on annual lime loss.

pH	Lime loss kg/ha CaCO ₃
5.0	120
6.0	240
7.0	480
8.0	960

Similarly calcium can be lost by the use of fertilisers, but why is this? Most inorganic fertilisers are based around sulphates, nitrates or chlorides which are negatively charged anions when disassociated in the soil. They tend to combine with dominant cation calcium in the soil and leach readily in the soil solution. Again work done at Rothamsted suggests that every kg of N as urea and ammonium nitrate needs to be balanced with 2-3 kg of CaCO₃.

Further work needs to be done to establish an ideal model for calcium losses but it is probably somewhere in the region of 50 - 100kg per hectare per year depending upon soil type, drainage etc. You cannot rely on the soil pH to be an indicator of satisfactory soil calcium, the two do not correlate well enough for these days of precision agriculture. I have lost count of the number of times I have heard the following phrase. "I haven't limed for several years, each time we check the soil pH the results show we don't need to lime". But when a cation exchange

analysis is undertaken the soil can be very low in calcium. Other factors are keeping the pH at a satisfactory level, which are detrimental to yield and soil health.

So why is calcium so important within the soil?

Firstly as mentioned above calcium is the dominant cation within the soil and as such plays an important role in soil aggregation due to the way its ionic charge, size and hydration acts upon the clay colloids. Soil aggregation or flocculation is the process by which soil colloids and organic matter clump together to form aggregates. It is these aggregates, or crumb structure, which we call tilth. It is this aggregation of the soil that creates pore space within the soil and consequently it is the pore space which allows water and air to move through the soil. As we all seem to be preoccupied with 'soil health' at present I always feel that calcium is a good starting point as it drives so many of the other factors which contribute to soil health.

Calcium is essential too for the soil biology (another function of soil health). The beneficial soil biology are generally aerobic (i.e. they need oxygen to function). It is the porosity created as described above by the calcium that allows the movement of oxygen to allow the biology to flourish. Equally the biology also requires large amounts of calcium to support their bodily functions.

Calcium within the plant..

All plants require calcium, it is an essential nutrient along with nitrogen, phosphate, copper etc etc. In fact it is the sixth most important element by concentration within plant tissues. Calcium uptake may be affected by the presence of other cations in the soil such as potassium, magnesium, ammonium etc. Similarly though excess calcium may reduce the uptake of these cations too, so it's not simply a case of over applying

in the hope that it may do some good. Excess soil calcium can cause as much trouble as deficiency. Calcium is mainly taken up with the soil water and moves within the xylem stream. Consequently when the transpiration rate is reduced calcium intake may suffer. Parts of the plant with a low transpiration rate may also be low in calcium such as the fruits. Once used within the plant calcium is reasonably immobile, consequently crops require a continuous availability of calcium. Calcium is an important element within the cell wall structure where it forms calcium pectate which give stability and bind cell walls together. Calcium pectate give the cells walls their structure and strength and gives the plant its standing strength and a higher resistance to fungal infections and aphid borne virus. Many fungi and bacteria secrete enzymes which impair cell wall integrity, calcium can help to reduce this effect. Calcium also plays an important part in fruit quality and starch formation amongst other functions.

Being immobile deficiency symptoms

show in the younger leaves and plant issues first. Typical symptoms are stunting of plants and lack of leaf expansion.

Useful forms of calcium

In agriculture terms we really only use three forms of calcium containing product, lime, chalk or gypsum. Lime can be further divided into calcitic or dolomitic lime. Calcitic lime contains calcium carbonate, as will chalk, while dolomitic contains calcium and magnesium carbonate. Gypsum contains calcium sulphate. All of these products are crushed and ground from rock and consequently the quality can be very variable depending upon the source. To enable these products to work effectively they need to be very finely ground to dust. Otherwise the release of calcium cannot be predicted. Dust is particularly difficult to spread accurately unless it is formed into a prill. Calcium carbonate also has a low solubility compared with gypsum, therefore the calcium will be

much more readily available from the gypsum compared to the lime. Another overlooked source is CAN, once a widely used fertiliser, but now consigned to horticultural crops it is a useful source of calcium plus the ammonium nutrition which is altogether better for crop health than nitrate.

Finally...

In conclusion, if you are trying to build a healthy soil and grow a healthy crop, calcium should be your first consideration, and just because your pH is correct don't assume you have the correct level of calcium for your soil. And finally, I don't sell calcium products but most soil tests I receive do suggest that our soils are in need of calcium.

References

Principles of Plant Nutrition 2001. Mengel & Kirkby

Crop Nutrition & Fertiliser Use 1996. Archer

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New drill & mobile app developments from John Deere

John Deere latest drill and mobile app developments are both designed to improve machine efficiency and productivity at lower operating costs.

The new ProSeries opener for the 750A All-Till drill will be available from January 2019 and can be retrofitted to existing machines. This replaces the 90 Series opener that has been a feature of the drill since its introduction in the mid-1990s, with global sales of well over two million units.

A key benefit of the 750A is the extremely low soil disturbance created at the point of drilling, which fits well with cultural methods for controlling grass weeds, particularly blackgrass. The new opener is designed to provide even less soil disturbance, more consistent seeding depth, better seed to soil contact and improved slot closure for more even crop emergence and potentially higher yields. It also features only one grease point and increased wear life to minimise annual maintenance costs.

In addition for 2019, John Deere will have new, fully ISOBUS compliant software available for both the 750A All-Till and 740A Min-Till drills, which works

with both John Deere and third party displays. As well as managing features such as section control, the software prevents overdosing in tramlines and provides a predosing function that prevents gaps in the field when setting off from a standing start.

Equipment logistics, efficiency and productivity can all be improved by John Deere's new MyOperations app, which allows users to see machine and field data remotely from their mobile phone or tablet and receive alerts on the go. This free app means farmers and contractors can experience less downtime as well as reduce operating costs, by always knowing where machines are and what they are doing.

The personalised Operations Centre in MyJohnDeere.com can also be used anywhere and at any time to reference both historic field operation information and current data coming off the field. This is managed under the key headings harvest, seeding, application and tillage.

The app has been available initially to new S700 Series combine owners for the 2018 harvest season, to make initial combine optimisation even easier. This option enables users to remotely view and change several combine settings to optimise grain quality and cleanliness of the sample, and minimise losses; the operator then just has to confirm the adjustments on the in-cab display. This allows maximum performance and quality to be consistently achieved, even while harvesting conditions are changing.

Use of the MyOperations app requires an online John Deere Operations Centre account connected to a machine's JDLink telematics system. It is suitable



for use with any internet connected smartphone equipped with iOS system 10.0 or Android system 4.4 or later.

After downloading the free app from the Apple App or Google Play stores, customers need to log into their existing account or register a new account at www.MyJohnDeere.com. JDLink connects the machine to the customer's account and with a suitable in-cab display, field operation and documentation data is available for analysis. Some additional features are necessary for use of the app with the S700 Series combine settings function.

Information available within the app includes location history, which shows where all machines in a business have driven on that day, a wide range of machine measurements including engine utilisation and fuel levels, field maps and productivity data including areas worked, and annual crop summaries.

Remote Display Access (RDA) is available within the app to support operators in the field. In addition, MyOperations users can view machine notifications such as geofence and curfew alerts, low fuel, file management and machine maintenance and diagnostic codes. Users can also edit preferences to receive prioritised alerts and notifications, so that field operations and logistics can be managed more quickly and efficiently.



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FARMERAMA: INNOVATIVE IDEAS FOR TODAY'S FARMER

By Olivia Oldham, Farmerama

Do you learn the most talking to other farmers? Don't always find the time to get out there and hear what's going on? Well that's what we are here for.

I am part of Farmerama Radio, an award-winning podcast released once a month sharing the voices of farmers in the UK and around the world. Farmerama is committed to positive ecological futures for the earth and its people, and we believe that the farmers of the world will determine this.

Each month we feature recordings of farmers in the UK and further afield, focused on practical tips, innovative ideas and the nitty-gritty of farming today. We are sharing knowledge of what really works in the field and for farming businesses, from farmer to farmer.

Every episode includes three to four different short stories that we weave together. Here we will give you a taster of four stories from four different episodes to whet your appetite. We definitely encourage you to give the episodes a listen because there is lots more to learn than what we cover here, plus it's always better to hear it from the farmer's mouth!

You can find the show online at www.soundcloud.com/farmerama-radio/ or farmerama.co, or if you already listen to podcasts then it's accessible on any podcasting service, just search for Farmerama.

Here we go...

Episode 36: Cowpat Lover Greg Judy at Groundswell Conference

In episode 36, we spoke with Greg Judy, a mob grazer based in Missouri, about how mob grazing provides a triple-win by improving soil health, grassland biodiversity, and farm profitability, all with the goal of increasing the long-

term viability of a farm. And all this can be achieved even with limited resources.

Mob grazing involves putting larger numbers of animals onto smaller areas of land, and moving them around daily, as opposed to giving them access to the whole field continuously. The mob grazing approach affects the biology, chemistry and physics of the soil. Biologically, it allows different grasses, the seeds of which are already in the soil, to germinate and come up. Mob grazing is also far more effective than continuous grazing at spreading manure across a piece of land. For example, Greg told us that on a farm of 100 acres, it would take 27 years under a continuous grazing management strategy to cover the whole farm with cowpats. With mob grazing, though,

the same coverage could be achieved in only one and a half years. This manure coverage improves the chemical and physical composition of the soil by providing extremely good fertilization and creating a better environment for worms.

None of this matters, though, if the farm enterprise isn't sustainable. Using the cattle's (or other livestock's) own natural waste reduces the need for fertiliser inputs, while using livestock to increase the variety of grasses in the pasture reduces the need to buy grass seed, for example. By moving the animals every day and keeping them away from their manure and urine, they are also kept away from the flies which are attracted to fresh waste. This is a simple and free way of keeping animals healthy and reducing the incidence of



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problems like worms. So, Greg says, “one of the best investments to make to improve farm profitability is in water infrastructure and fencing to be able to implement mob grazing”.

Speaking of sustainability, Greg emphasised that more than being sustainable, we should be aiming to be regenerative. If we come onto land that has been degraded by unsustainable practices in the past, we don't want to 'sustain' it at its existing levels – we want to regenerate it and make it better for future generations. Mob grazing is one way to do this, using animals to restore soil health. An extended interview with Greg can also be found in this month's short.

Episode 35: California Paying Farmers to Sequester Carbon with Charles Schembre

In episode 35, we learned about California's Healthy Soils Program, a scheme which compensates farmers for increasing their soil health – with the goal of sequestering carbon and increasing water retention. For example, one farm is being paid USD50,000 to sequester 345.6 tonnes of greenhouse gases per year. They plan to do this by transitioning to a minimum-tillage approach, planting multi-species legume cover crops, and spreading compost across 70 acres. The quantities sequestered under the scheme are estimated using CARB GHG [carb G-H-G] Quantification Methodology and tools.

This Healthy Soils Initiative is particularly relevant in the UK at the moment as the government considers how farming subsidies will operate after Brexit.

We hear an on the ground account of the Healthy Soils Initiative from Charles Schembre, a long-time grower, farm manager and soil conservationist and now a Vineyard Conservation Co-ordinator at Napa County Resource Conservation District. Charles told us that the Healthy Soils Program is the first time in the United States that it has been recognised at a state-level that soil regeneration is an effective weapon in the climate-change-mitigation arsenal.

Charles pointed out that it can be tempting to look at soil regeneration

through a narrow 'carbon-sequestration, climate-change' lens, but it is important to take a broader view. Regenerative soil management can improve the entire ecological function of the land, including water retention, the reduction of erosion, yield enhancement, and habitat creation. Taking a more holistic view also involves stepping back from the traditional farming lens many of us have had since at least the end of the second world war and begin to question why we do the things we do, why we think things should look a certain way or with a certain technique or approach. For example, Charles said that as a Californian farmer, he might see a field with long grass and, having been conditioned to think in a certain way, add mowing the field to his list of jobs. But if he stops to think critically and holistically about that task, he might remember that, biologically, chlorophyll is necessary to pull carbon out of the atmosphere and into the soil. In a dry place like California, mowing pretty much kills the plants and eliminates much of that sequestering potential. Additionally, when grass gets quite tall, it captures dew much better and allows the top-soil to stay more moist (anecdotally at least). “If you want to capture carbon,” said Charles, “you've got to think like carbon.”

You can hear more about the carbon farm plans Charles has worked on (together with the Carbon Cycle Institute) for 4 vineyards in Napa county, and details of how they monitor soil health and carbon sequestration, in this month's short.

Episode 28: Using Fungal Innoculants to Foster Perennial Grasses with Joel Williams

Finally, in episode 28, we spoke with Joel Williams of Integrated Soils about using nothing more than the microbial balance of the soil to manage weeds. Although his example related to golf courses rather than pasture, the same principles apply! On golf courses, groundskeepers cultivate certain species of perennial grasses which are best for creating a smooth, fine playing surface. Other types of grasses, like an annual called meadow grass, are

difficult to manage, because herbicides cannot be used to manage them. Both are grasses, and so a herbicide would affect not only the unwanted 'weed' grass, but also the desirable perennial.

Joel explained that you can apply fungal 'innoculants' to do the job instead. Essentially, this means applying beneficial fungi, and food to feed the fungi, to the soil. The soil becomes more fungal-dominated, which is an environment more favourable to the perennials the groundskeepers want, and less favourable to the annual they want to get rid of. The perennials grow with more vigour, while the annual becomes stressed, and within a season or two, the perennial is able to outcompete the annual.

Joel emphasised that it is important to remember that soils are very complex ecosystems, despite our tendency for simplification. Although simplicity is important to make things easier to understand, taking too narrow a view can be detrimental. When trying to improve soil health and anything that flows from that, such as crop yield, we have to take a step back and not box ourselves into one or two parameters in our attempt to make assessments on the health of the system. Soil chemistry is relevant, of course, but so too is soil physics and its structural properties, such as aeration, and soil biology. It is crucial, also, to remember that living plants are another part of the soil picture – they contribute to soil health, for instance, by drawing down carbon from the atmosphere. According to Joel, “soil and plants are one.”

If you have a story you want to feature on the show or know someone who we should feature, then please get in touch via our website farmerama.co. You can also find us on facebook, twitter @farmerama__ and instagram @farmerama_radio.

We look forward to hearing from you!



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DRILL MANUFACTURERS IN FOCUS...



TIMING IS CRITICAL FOR EFFECTIVE STUBBLE MANAGEMENT

Timing is everything in farming and 2018 demonstrated just what a huge difference even a few days can make when it comes to creating the ideal conditions for crop establishment, writes Jeff Claydon, who farms in Suffolk and designed the Claydon Opti-Till® System.

In the last issue of Direct Driller magazine, I highlighted the importance of effective stubble management in any efficient, sustainable, profitable production system. In this edition I want to take that a stage further by outlining our findings in terms of the timing of stubble management operations, as this is critical.

To maximise profitability on the Claydon farm our goal is to produce consistently high-yielding crops at the least cost per tonne. That is what I designed the Claydon Opti-Till® System to achieve and that is exactly what it delivers, providing you understand the approach and how to use it correctly.

In terms of soil structure 2018 was a vintage year. The extended period of hot, dry weather created wonderful natural, deep fissuring, while the early harvest meant that combines and associated equipment caused minimal compaction, an excellent starting point from which to establish excellent crops.

After harvest the weather was ideal for an extended, highly-effective stubble management programme, with frequent light showers bringing just enough moisture so that weeds and volunteers germinated in seven to 10 days. We were able to complete four or five passes with our 15m Straw Harrow before drilling winter cereals with the 6m Hybrid drill. At the time of writing this mid-way through November all our crops look quite remarkable, very clean and full of potential.

A combined approach



The new Claydon T6c, which will be launched at LAMMA 2019, drilling winter wheat on the Claydon farm in October.

A critical component of our system is to encourage weeds and volunteers to germinate quickly after harvest so that they can be taken out, between crops, using a combination of mechanical and chemical methods.

Over the years we have evaluated various zero/low disturbance set-ups, but all our trials have shown this approach is deeply flawed here, and fraught with risks. In very dry weather the soil can bake as hard as bricks and roots cannot push through the compacted layers, while wet plastic conditions cause seeds to rot because water cannot drain away. You need only to look down wheelings and a tramline to see the impact of compaction! Because of these fundamental shortcomings this approach makes it difficult to deliver the consistent, high yields achieved with the Claydon leading tine set-up, which creates optimal tillage and drainage in the seeding zone.

To get the best from the Opti-Till

system we carry out an initial pass with the Straw Harrow as soon as possible after the combine has done its job, while weeds and volunteers are at the cotyledon stage. At that point they are easy to control mechanically, but if left to develop two or more leaves the job becomes much more difficult. When carrying out post-harvest cultivations it is therefore essential to retain enough moisture in the soil to encourage rapid germination so that we can take out the cotyledons, then keep repeating that process.

On my travels around the country after harvest I saw a lot of farms wasting time, fuel, wearing metal and money on recreational tillage, using a variety of approaches. Most were simply moving too much soil, causing it to dry out and producing entirely the wrong conditions for effective stubble management. Weed seeds and volunteers were buried deep in dry soil and took much longer to germinate,

so many farms were forced to delay drilling and that resulted in poor crop establishment. The results are there for all to see in the form of patchy, uneven establishment with weeds/volunteers emerging in the growing crops, where they are much more difficult and expensive, if not impossible, to control.

On the Claydon farm this autumn we used only a 15m Claydon Straw harrow to manage the stubbles followed by a 6m Hybrid drill to establish our combinable crops, with plenty of spare capacity to take on an additional 400ha contract work. It couldn't get much simpler than that. However, to achieve optimum results requires the use of the right equipment, in the right way, at the right time.

Timing is critical

The key to effective stubble management is to appreciate the different requirements in winter and spring cropping situations, know how and when to use the Straw Harrow, then tailor operations to your own

soils and conditions.

It's all about disciplining yourself to go in with the Straw Harrow even though it might seem too early because few weeds are visible. Look closely, though, and you will find countless, barely-visible cotyledons ready to emerge, and this is the very best time to take them out. Multiple passes with the Straw Harrow will also knock out slugs and destroy their eggs, helping to create ideal conditions for drilling and crops that germinate evenly in 7 to 10 days.

Within a week of finishing harvest on 24 July we straw harrowed the entire farm to distribute the chopped straw evenly and create a fine, level, 2cm-deep tilth to provide the high-humidity conditions necessary for weeds and volunteers to germinate rapidly. Straw Harrowing also halted the soil's natural capillary action, preventing water from being drawn up to the surface and the surface from drying out, with the action of wind and sun, to form a hard, impermeable layer.

Farmers sometimes comment that we carry out more passes with the

Straw Harrow than they do with a conventional establishment system, but this low-draft operation is at 20kph, covers 20+ ha/hour and uses less than 2.5 l/ha of diesel. It is fast, cheap and very effective, so we can cover the farm four times with the Straw Harrow for roughly the same cost as one application of glyphosate. This is vital to help preserve this valuable chemistry. When, eventually, we apply glyphosate it is as a single, full-strength dose prior to drilling, which maximises its effectiveness and reduces the risk of resistance.

After that initial pass, we used a range of timings with the Straw Harrow tailored to weather conditions and follow a different approach on fields which will be drilled in the autumn to those which will be spring sown. To illustrate that, I will look at three fields, '20-acre', 'shop' and '80-acre', all of which have the same heavy clay soil that must be managed correctly. The former was drilled with Siskin winter wheat, while the other two are earmarked for spring oats.

Field name	'20-acre'	'Shop'	'80-acre'
Crop	Siskin winter wheat	Spring oats	Spring oats
Straw Harrow – 1	27 July	27 July	28 July
Straw Harrow – 2	15 August	8 August	21 August
Straw Harrow – 3	25 August	21 August	10 September
Straw harrow – 4	3 September	1 September	29 September
Apply Roundup (3l/ha)	3 October		
Straw harrow – 5	8 October	1 October	
Drill	9 October		

From the table you can see that on '20-acre' we left four weeks between the fourth pass with the Straw Harrow on 3 September and the final pass on 8 October, which was five days after applying full-strength Roundup. That interval provided plenty of time for weeds and volunteers to germinate, and by Straw Harrowing just before drilling we killed any that were growing just below the surface but would have been untouched by Roundup. The crop was then drilled quickly and efficiently the following day, below the 3cm of tilth, into the preserved moisture which allowed it to get away rapidly. Due to



This is 'Shop field', which will be drilled in the spring. Notice how four passes with the Claydon Straw Harrow, at an average of 10 days apart, has resulted in almost perfect control of weeds and volunteers.



Jeff Claydon in a crop of winter oilseed rape being grown in a field that has seen only a Claydon Straw Harrow and Hybrid drill in the last 16 years.

the action of the Straw Harrow there was enough moisture in the soil for pre-emergence herbicides to work effectively.

A different approach

On 'shop' and '80-acre', which will be drilled in the spring, the first pass with the Straw Harrow was carried out at the same time as on '20-acre', but then there was a difference. The average time between passes on 'shop' field was 10 days, compared with an average of 19 days on '80-acre'. Our research highlighted that any more than two weeks between passes with the Straw Harrow allowed the plants to become much stronger and more difficult to kill. It's clear that tightening up the intervals between passes with the Straw Harrow greatly reduces the number of plants present.



'80-acre' received the same number of passes as 'Shop', but at an average of 19 days apart. Claydon research has demonstrated that reducing the intervals between passes with the Straw Harrow greatly reduces the number of plants which are present.

'80-acre' has not been touched since the end of September, has greened-up nicely and shortly will be sprayed off with Roundup ahead of spring drilling. Having the chopped straw nicely mixed into the top 2cm to 3cm of soil encourages worms to proliferate and take down surface residues. The weathering action has left the soil in perfect condition for a final pass with the Straw Harrow just before drilling and having 2cm – 3cm of lovely, crumbly frost tilth on the surface will provide a perfect seedbed.

Much has been said and written about cover crops and some people swear by them. We are still evaluating their potential and have not reached any firm conclusions, but it's very much a question of balancing their cost against the potential benefits, such as the nutrient value and soil conditions. Our



The Claydon System creates an abundance of worms, which quickly take down crop residues, helping create correctly structured soils with the right air:water balance and a layer of friable tilth on the surface.

approach on fields that will be spring drilled is effectively to use weeds and volunteers as the cover crop only during the autumn, taking care not to let slug numbers build up.

When we drill it is not to a set date but based entirely on soil conditions and soil temperature. We consider carefully what conditions each type of seed requires to deliver optimum performance, as the type of rooting structure it produces will affect the depth at which the front tine needs to be down and hence the set-up we use. In the spring, particularly on our clay soils, care is needed not to create plastic compaction which will press the soil particles tightly together, squeeze out any air, cause the surface to bake hard and create a layer which young plants will find difficult to penetrate, thereby stunting their development.

When drilling in the spring we will run the leading tine on the drill shallower than for autumn sowing so as not to dry the soil out, keep as much of the

lovely frost tilth created over the winter on top and avoid bringing cold, wet soil to the surface where it can cause issues with establishment and reduce the effectiveness of herbicides. This is essential to ensure that crops get off to a vigorous start in warm, moist conditions, with a valuable 3cm of tilth protection.

We normally drill with the front tine 10cm deep in the case of winter cereals, 15cm for oilseed rape. RTK guidance means that the rows are evenly spaced and straight, which will allow any resistant weeds that appear between the bands to be taken out using our 6m TerraBlade inter-row hoe, which we developed to extend the range of control options that we have available and potentially reduces our use of and reliance on a dwindling number of herbicides

In the next issue I will look at how we establish spring crops and look ahead to what we will be doing both in the run-up to harvest and in preparation for autumn drilling.



Crops which emerge and grow evenly will help out-compete weeds. Drilled on the Claydon farm at the beginning of October, this was how the winter wheat looked on 12 November.



Evenly-spaced bands will allow any weeds growing between them to be taken out mechanically using a 6m Claydon TerraBlade inter-row hoe.

Top Tips for Successful Establishment

1. check your fields for issues with pests and weeds and address these accordingly
2. ensure your combine's straw chopper and chaff spreader are set correctly with sharp blades, correct belt tension and adjusted vanes maximising the chop and spread
3. start your stubble management programme as soon as possible after harvesting the previous crop
4. inspect the field 7 days after the initial straw harrow pass to check for weeds, volunteers and slugs. If present, carry out a second pass.
5. continue to do that, but stop 2 to 3 weeks before drilling so that weeds and volunteers have time to grow and provide enough contact area to enable a non-selective herbicide to work effectively.
6. avoid drilling into situations with no tilth or severe rooting turf, as seed to soil contact can be compromised particularly on heavier soils
7. drill seed into a shallow tilth to seeding depth, with the leading tine set correctly to create breakage for autumn sowing, taking care not to run too deeply in the spring
8. consider straw harrowing lumpy seed beds on heavy land behind the drill and roll
9. apply pre-emergence herbicide

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GETTING THE BEST OUT OF A JOHN DEERE 750A

By Richard Harding - Agronomist Extraordinaire

Simon Chiles has been advocating the benefits of the John Deere 750A drill for over 18 years. While carrying out his contracting business he has drilled almost every conceivable crop and as a contractor he has also had the benefit of drilling most soil types, from light chalky soils and sands through to silty and Gault clays. He has an engineering background and maintains that the performance of any machine is governed more by the operator than by any other factor. When asked by a farmer if he would show him how to set up his new drill the thought occurred to him that others might also benefit from such instruction.

He could not, however, have anticipated how great the demand would be. His initial courses were attended by large groups of people but he now prefers to keep the number in each session down to a maximum of ten. "I've learnt that people get far more benefit from smaller groups. They tend to open up more and the conversation seems to flow better. I

also discovered that it pays to split the day into two halves. The first half deals with the drill and its operation; the second half is more about direct drilling as a system. The John Deere drill has lots of different adjustments that you can make to it. Each one can sometimes interact with another so it really pays to understand what the effects of the drill settings are on the soil and on drilling performance.

If the necessary time is spent to set the drill up properly it can achieve excellent results," he says. Simon tries to arrange his drill courses over the winter months and around the country so that no one has to drive too far to one, although several people have flown in from further a field to attend. He has quite a demand for courses again this winter and is sorting out venues and possible dates at the moment. For anyone wishing to attend a course you can contact him via email at notilopenday@outlook.com or via Twitter on @SimonChiles

The top 5 operator drilling mistakes Simon encounters are:-

- 1 Trying to drill in unsuitable conditions, going two weeks earlier in the autumn and two weeks later in the spring are his rule of thumb.
- 2 Not being cautious enough about the effect decaying gaminacious material (from either chopped straw or ground cover) can have in anaerobic conditions.
- 3 Not running the coulter pressure in constant pumping.
- 4 Not adjusting the coulter pressure correctly for soil conditions. Often coulter pressure is run too high.
- 5 Not adjusting the fan speed to the seed size and application rate.



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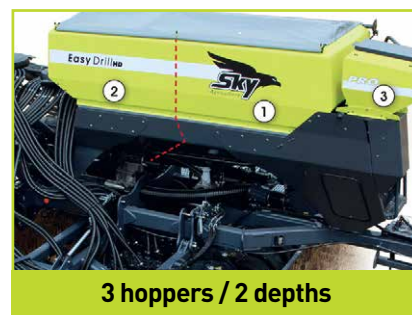


Designed for perfect seeding in no-till, min-till, & conventional establishment systems making it a truly versatile drill.

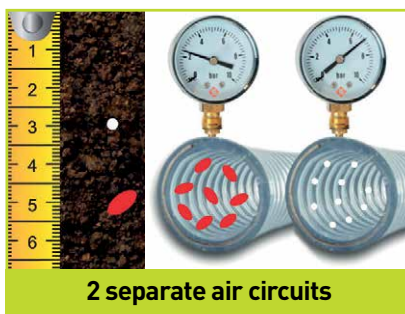
- Up to 3 separately metered hoppers
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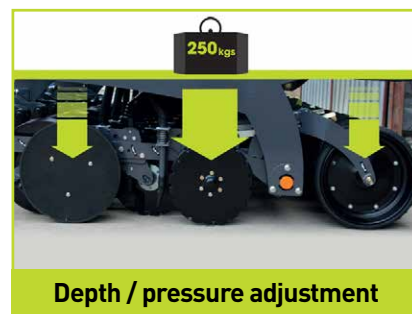
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3 hoppers / 2 depths



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FIELD PEA DEMONSTRATION TRIAL 2013 RESULTS

Tom Molloy and Ellen Mallory University of Maine Cooperative Extension

Organic field peas are of interest in Maine as a high protein feed source and a rotation crop for cereals. A trial was established at the University of Maine's Aroostook Farm in Presque Isle in 2013 to demonstrate organic field pea production for grain. The variety DS Admiral was planted alone and in mixes with barley and oats. Funding for this trial was provided by Organic Valley and the Grantham Foundation.

Field Pea Types

The variety DS Admiral is a yellow cotyledon, determinant, semi-leafless variety that is suitable for grain production. Grain-type field peas tend to be determinant types that have a fixed flowering period and shorter vines (2-4 feet). DS Admiral is also one of the semi-leafless types with modified leaflets that act like tendrils. Both the shorter vine length and increased tendrils greatly improves the standability of determinant, semi-leafless peas making them much easier to dry down and harvest. In contrast, forage- type peas are indeterminate, have normal leaves, and produce vines up to six feet long. Field peas are also classified based on their cotyledon or seed color. Yellow and green types can be grown for either food or feed markets, depending on the variety. The DS Admiral for this trial was sourced from Johnny's Selected Seeds.

Growing Peas with Cereals

Growing peas in mixes with cereals is commonly done for cover cropping or for forage production. In regions where peas are grown for grain, they are usually grown as a monocrop. However, it is thought that growing peas in mixes with cereals could help reduce lodging and weed pressure.

Designing the right mix requires matching the pea and cereal varieties for maturity and mixing the seed at a ratio that benefits both crops. For instance, work done in Maritime Canada showed that going above 20% of peas in the seed mixture increases lodging potential (OACC interim report E2006-11).

Methods

In this trial, DS Admiral field peas, three varieties of barley, and one variety of oats were grown in monocrop and in mixtures (Tables 1 and 2). The barley varieties were Conlon, Newdale and Kawartha, and the oat variety was Colt. In addition, the barley/pea mixes were planted at two different mix ratios, one where the pea seed made up only 10% of the seeds planted and another where the pea seed made up 19% of the seeds planted. The Colt oat/pea mixture was planted with 21% peas in the mix.

The field where this demonstration took place had been in conventional potatoes the previous year. The soil type is Caribou gravelly loam. Chicken manure was spread at a rate of approximately 3 tons per acre on May 13 and immediately incorporated with a disk harrow. Because peas can fix most of their own nitrogen,

spreading manure ahead of field peas is not a recommended practice, but due to other experiments occurring in the same field, manure had to be spread uniformly throughout the field. Final seedbed preparation was done with a Vibrashank seedbed conditioner and planting occurred on May

14. Peas, barley, oats, and mixtures were seeded with an Almaco small-plot cone seeder with 6.5-inch row spacing. Plots were tilled weeded on June 5 with a Lely weeder when the peas were approximately 3 inches tall. The plots were harvested on August 31 with a Wintersteiger small-plot combine.

Results and Discussion

The results from this trial are from non-replicated demonstration plots, so this information should be used only for getting a general estimate of the potential for organic field pea production in northern Maine.

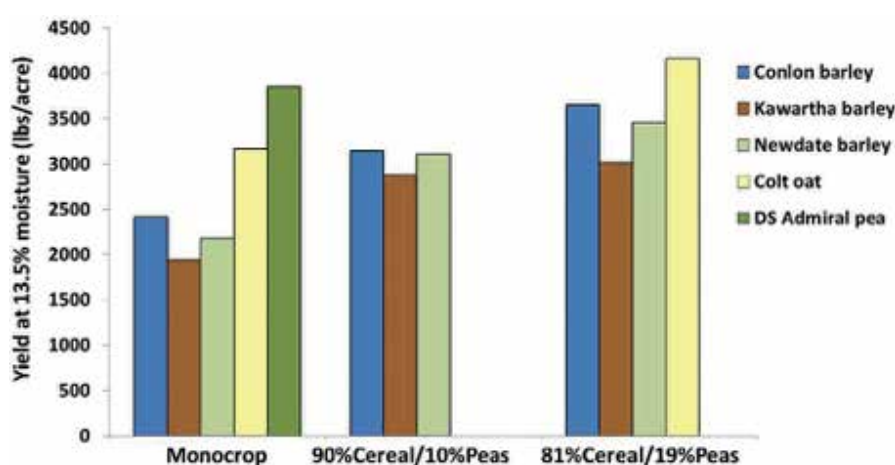
The yield of DS Admiral grown as a monocrop was quite good at 4,022 lbs/acre. The barley variety yields ranged between 1,940 and 2,407 lbs/acre and the oat yielded 3,161 lbs/acre when grown alone (Graph 1). The yields of the various cereal/pea mixes were greater than the cereals when grown alone, but similar to the monocrop pea.

Table 1. Seed characteristics and monocrop seeding rates.

Crop	Variety	Germination (%)	Number of seeds/pound	Seeding rate (#/square foot)	Seeding rate (lbs/acre)
Field Pea	DS Admiral	85	2,318	9	199
Barley	Conlon	97	12,077	33	121
Barley	Newdale	96	8,887	33	103
Barley	Kawartha	90	11,068	33	142
Oat	Colt	90	15,569	33	101

Table 2. Seeding rates of pea/cereal mixes.

Varieties	Percentage of pea seed in the mix (%)	Seeding rate (#/square foot)			Seeding rate (lbs/acre)		
		Pea	Cereal	Mixture total	Pea	Cereal	Mixture total
DS Admiral/Conlon	10	3	28	31	66	104	170
DS Admiral/Newdale	10	3	28	31	66	142	208
DS Admiral/Kawartha	10	3	28	31	66	122	188
DS Admiral/Conlon	19	6	23	29	123	86	209
DS Admiral/Newdale	19	6	23	29	123	119	242
DS Admiral/Kawartha	19	6	23	29	123	102	225
DS Admiral/Colt	21	4	14	18	82	43	125



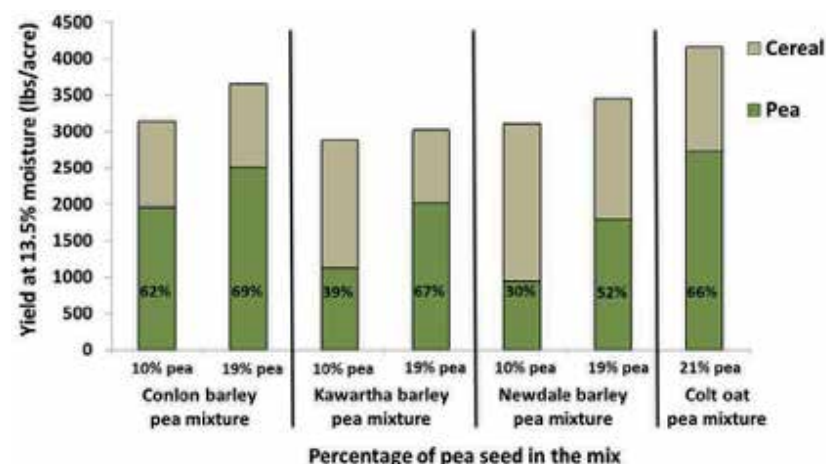
Graph 1. Yield of the monocrop cereals, field peas and cereal/pea mixtures.

Graph 2 shows the total yield of the mixes as well as the yield of the individual components of each mix. Increasing the amount of pea seed in the planted mix by 90% (from 10% to 19% of the mix) increased the portion of the pea grain in the harvested crop by about 70% with the Kawartha and Newdale barley varieties but only by 11% with Conlon. Peas made up 52-69% of the harvested grain at the higher pea mix

and 30-62% at the lower rate. The Colt oat/pea mix had yields similar to the pea monocrop with the peas making up 66% of the harvested grain.

Summary

In this demonstration trial, the yield of the field pea variety grown alone was quite good and comparable to hard red spring wheat yields here in Maine.



Graph 2. Total yield of cereal/pea mixes and the percent of the harvested grain that was pea.

Mixing field peas with cereals did give an improvement in yield over the monocrop cereals, but the monocrop field peas still out yielded the pea/cereal mixes with the exception of the pea/oat mix. Lodging of the pea plots was noted throughout the field and could not be linked to any one seeding practice. Excessive rainfall and the use of manure as a fertility source could have exacerbated the lodging problem. Because peas are not as competitive with weeds as cereals, there still might be a system level benefit of growing peas in mixtures with cereals.

Additional Resources

For more information on grain pea varieties and production practices see the following publications.

Field Pea Production, Bulletin A-1166, North Dakota State University. <http://www.ag.ndsu.edu/pubs/plantsci/rowcrops/a1166.pdf>

North Dakota Dry Pea Variety Trial Results for 2013 and Selection Guide, NDSU. http://www.ag.ndsu.edu/pubs/plantsci/rowcrops/a1469_13.pdf

Alternative Field Crops Manual, University of Wisconsin Extension. <http://www.hort.purdue.edu/newcrop/AFCM/index.html>

Growing Field Peas in Montana, MT 9520, Montana State University Extension Service. <http://www.ipm.montana.edu/cropweeds/montguides/Growing%20dry%20pea%20MT200502AG.pdf>

Managing Field Peas Organically, Lakeview Organic Grain. http://www.lakevieworganicgrain.com/info_docs/managing%20peas%20organically.pdf

OPTIONS TO IMPROVE WATER-USE AND NUTRIENT-USE EFFICIENCY IN CROPS

By Dr Niki Rust, Research Associate, Centre for Rural Economy, Newcastle University

December 2018 issue

We all know that some parts of the UK are getting more and more water- and nutrient-stressed over time. With less predictable rainfall, extended periods of droughts or heavy rainfall, and declining nutrients in some soils, it is becoming increasingly difficult for farmers to grow crops in a similar manner to what they had done in the past. To keep up with this changing world, we are finding that we ourselves are having to change.

Historically, when crops have not had enough nutrients, we've turned to inputs like fertilisers. However, with increasing costs coupled with more restrictions on their use – and more regulations likely in the future – we're having to innovate to find ways to improve nutrient-use efficiency of our crops. In terms of water, irrigation is one way to get around lack of water in the soils, but it is harder to deal with too much precipitation from rainfall. Some scientists have predicted that UK

weather will become more unstable in the future, with more frequent outbursts of heavy rain followed by extended droughts. How we deal with these challenges whilst keeping farming profitable and productive still remains somewhat of a mystery.

Like farmers, the European Union is concerned about how to continue producing enough food for our population in these uncertain times. It has therefore provided funding for research into methods to improve water-use efficiency (WUE) and nutrient-use efficiency (NUE) for a number of staple European crops. SolACE is such a project, which stands for Solutions for improving Agroecosystem and Crop Efficiency for water and nutrient use. This cross-disciplinary and collaborative research involves natural and social scientists, crop breeders, farming organisations and other agricultural stakeholders from across Europe to develop and test methods that improve

crop production in areas of water- and nutrient-stress.

The techniques we are testing include microbial inoculants, cover crops, genotype mixtures, hybrids, fertiliser additives, participatory breeding, decision support tools to improve WUE and NUE, and conservation agriculture based on minimum/no till. We are running controlled experiments at field stations in five countries alongside on-farm trials in seven countries to test how these techniques affect WUE and NUE in durum wheat, bread wheat and potatoes.

As part of the project, we want to learn from crop producers about what they think encourages or discourages uptake of practices that can improve their crop's WUE and NUE, as well as what methods you currently use to deal with these issues. We are especially interested in hearing what you think will incentivise uptake, such as changes in policies, taxes, subsidies, regulations or education campaigns and knowledge transfer exchanges. We are running a short, 10-minute online survey to collect your views on this. The survey can be accessed here: <https://goo.gl/forms/NX5TkN7F1O5Csv1e2> or by using the QR code below. Please do feel free to share this survey widely with your farming contacts.

If you'd like more information on the project, you can access our website here: <http://solace-eu.net> and you can get more involved by joining our Stakeholder's Forum <https://www.solace-eu.net/get-involved.html>. If you have any comments or questions on the survey, please feel free to contact me at niki.rust@ncl.ac.uk and I would be more than happy to hear from you.



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DRILL MANUFACTURERS IN FOCUS...



OPTIONAL EXTRAS ENHANCE KUHN'S CULTIVATORS

KUHN Farm Machinery has launched a variety of optional accessories to enhance its range of PROLANDER, CULTIMER AND OPTIMER cultivators.

PROLANDER: new tine, toughened share and roller options

The PROLANDER range of vibrating tine stubble cultivators receives a new tine which uses a single bolt to hold a hard-wearing, easy to change and reversible share in place.

The single-bolt design reduces the amount of downtime incurred when replacing worn parts, while the heat-hardened share, which is also thicker than standard versions, has a lifespan up to 20% longer than ordinary, non-hardened parts.

A new tube and bar combination roller is also available for the PROLANDER: a 550mm diameter tube roller and 420mm bar roller are mounted together to ensure excellent soil crumbling and weed management when working stubbles on a min-till basis.



The PROLANDER's new single-bolt tine and toughened share reduce downtime thanks to greater wear tolerance and faster replacement tines.



KUHN's new V-LINER roller optimises soil crumbling in heavy conditions. The V-shaped press rings are divided by cleaning blades which can be retracted when working lighter soils.

CULTIMER and OPTIMER: new V-LINER roller

A new V-LINER roller is available for KUHN's CULTIMER (tine) and OPTIMER (disc) cultivators: featuring v-shaped press rings at 12.5cm intervals, the V-LINER ensures good soil consolidation, even in wet

conditions.

Cleaning blades are located between each neighbouring pair of rollers to prevent clogging and to enhance the crumbling of heavier soils. These blades can be retracted to avoid excessive consolidation when working in loamy soils.

CULTIMER: continuous hydraulic adjustment

The CULTIMER range has been further enhanced by the optional inclusion of KUHN's continuous hydraulic adjustment system. This system, which is already available on the OPTIMER XL and PROLANDER ranges, enables the working depth of the cultivator to be adjusted from the comfort of the tractor cab: this not only enables the cultivation depth to be adjusted as soil conditions change, but also reduces operator fatigue, fuel consumption and machine downtime, thereby increasing daily output.



The PROLANDER's new tube and bar combination roller uses a 550mm diameter tube roller and 420mm bar roller to provide excellent soil crumbling and weed management.

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FEATURED FARMER

MARK LEA - AGRICOLGY



Agricology is a community of farmers and researchers sharing knowledge and experience on agroecological farming practices; online and in the field. We are a free service to support all farmers and growers to transition to more resource efficient, resilient and profitable farming systems, regardless of labels.

Mark Lea is a farmer profiled on the Agricology website who has put diversity at the centre of his mixed, low-input farming system in Shropshire. Here he shares some of his experiences with growing alternative cereals, agroforestry and intercropping (adapted from the profile).

'Green Acres is a 223ha mixed farm, with a five-year arable rotation including red clover for seed or silage, wheat, oats and peas. We have been breeding cattle for 10 years (we have a herd of pedigree Hereford cattle) and have recently introduced sheep primarily to help with weed control. We have been organic for 18 years and are certified by OF&G. We are on sandy /clay loam soils and run a compost business, providing the opportunity to enhance our soils and

also diversify the business.

It is all about diversity! First of all, it makes life more interesting! But we also think that diversity across the farm builds resilience. We are keen to increase diversity of the crops, the business and the people we work with. Connecting with the people who eat and process our food makes us feel like food producers rather than commodity producers and is much more rewarding!

We started working with Homedod's (who won the 2017 BBC Food and Farming Awards!) about 5 years ago. We valued peas in our rotation but felt they were not fairly valued by markets, especially given how difficult they are to grow. We started growing yellow, blue and marrow fat and carlin peas for Homedod's. This has helped

us to maintain a diverse rotation and build meaningful connections with our customers.

Rotation, livestock and cover crops

Our rotation is changing all the time but currently includes clover ley, winter wheat, fodder beet, spring peas, and spring oats undersown with clover. We will see how successful the beet is, but the principle of a completely different crop has clear merits in relation to interrupting the lifecycles of some of our problem weeds.

We have always had cattle but this year brought in sheep to help with weed control (particularly docks). We don't have too much ambition to make large profits out of them but



Spring oats undersown with clover



Combining the 30% triticale in full rate Carlin peas in Innovative Farmers Field Lab trial

feel they add to the diversity of the business. We see the advantages, but it has been hard work!

We have been growing 1 year leys - undersown so they last for 18 months. We have now diversified the mixtures and are adding more grass species and clover. We are interested in more diverse mixtures, but as we have a short ley we are not sure we would get the benefit from the deeper rooting species etc. to justify the cost.

We have increased diversity in our cover crop mixtures and moved from just using brassicas to a 7 or 8 species mix in one field, and for the first time have added seed into mixtures (buckwheat and phacelia) to encourage mycorrhizal fungi.

We have more biodiversity on the farm because we don't spray and weeds and pests are not always the problem we thought they were going to be!

Crop diversity

I am keen to enhance diversity at a crop level - over time by diversifying the rotation and in space through practices such as undersowing and intercropping.

Carlin peas, marketed as 'black badger', are traditionally eaten on bonfire night in Lancashire. They have a lot of biomass and often end up on the floor, affecting yield and quality, so I was looking for a cereal to provide some scaffolding.

Last year, as part of the DIVERSify / Innovative Farmers Field Lab, we did an intercrop trial with different seed rates of triticale (0%, 5%, 10%, 20% and 30%RD) in full rate carlin peas (240kg/ha) in 1 ha strips across the field to see what the impact would be on lodging. Visual assessment at harvest suggested that 20% and 30% were doing the best job at holding the crop off the floor (although the thistles were also helping in the 0%!) and the 30% was definitely the easiest to harvest. However, analysis of the yield showed no significant difference between the treatments. This was a low lodging year and there was not a large amount of loss in any of the treatments, but I think that if we were to do it again I would go for the higher

rates and possibly higher.

We have been undersowing since the farm became organic - usually when crops are about 8 -10 cm at tillering - early May. We use an Opico harrow with an air seeder and broadcast it into the harrow - we may do it next year with a homemade front mounted air seeder.

In our genes...

We are growing heritage varieties and populations which we think have a lot of potential in a low input sustainable farming system. Weed suppression can be fantastic, they are good at scavenging nutrients and they could hold resilience to pest and climatic variability that we have lost in breeding modern varieties.

For the last few years we have been growing the ORC Wakelyns Population; a highly heterogeneous winter wheat made from 190 crosses of 20 different varieties. We grow it because of the increased resilience to pest, disease and climatic risks that we gain from having so much genetic diversity in the mix. Some of this has been sold to bakers such as Small Food Bakery in Nottingham (winners of 2018 BBC Food and Farming Awards!). We have really enjoyed building relationships with people along the value chain who are interested in how we produce food and want to support us to farm using agroecology. Longer term we are also considering establishing an on-farm mill.

We are part of a network of seven farmers trialling organic wheat varieties with the Organic Research Centre and Organic Arable. We are each growing a selection of winter wheat varieties in different combinations to enable comparison between them. I have chosen to grow all seven varieties to help showcase the trial and to gain more insight on the farm. The enterprise is being funded in part by LIVESEED, an EU project designed to try to boost organic seed and breeding across Europe.

Agroforestry

We are also building agroforestry into our system and are in the second

phase of planting trees, this time from the Woodland Trust. We have planted wide rows with 9 hazels planted inbetween rows of walnut. The idea is that the hazel will be cut on a 5 year rotation, with 20% cut each year, to provide wood for our biomass boiler. The rows are running east to west to provide maximum shade and shelter on the north side, where it borders with a field which has a grass ley in rotation. The idea is that it will provide shade for cattle in summer and shelter for sheep in winter. As the grass ley is coming out, we will harvest from the line on the edge, that way the cattle and sheep will have the benefit of the highest line of hazel.'

MARK'S TIPS

- Embrace diversity in every way! It's a fashionable thing to say, but it's true!
- Get closer to your market and become food producer - bakers, millers - they will inspire you, give you new ideas and make life more interesting!
- Don't be afraid to try things out!

Visit agricology.co.uk for the full version of this and other farm case studies. Agricology is an independent collaboration of over 20 of the UK's leading farming organisations (see our partners.) Each month we profile a farmer using agroecology to enhance their farming system, and have a wide range of farmer videos on our YouTube page. Blogs and research hubs provide a space for researchers to share their learnings with the farming community. Our growing library hosts over 350 resources on different agroecological practices (such as soil monitoring, companion cropping and herbals ley). Subscribe to the newsletter or follow us on social media @agricology to share your questions and experiences with the Agricology community.

AGRICOLGY
SUSTAINABLE PRACTICAL FARMING



PUSHING PERFORMANCE WITH AMINO ACID BIOSTIMULANTS

By Sarah Ferrie, Marketing Manager at Interagro (UK) Ltd

Could amino acids be one of the most overlooked assets in plant nutrition? In this feature we take a look at how supplementing the crop with amino acid biostimulants in-season not only boosts plant health and development, but can also help crops reach their genetic yield potential.

On a cold wet day in summer 2017 we got our first insight into the real power of amino acid biostimulants. A crop of sugar beet on its last legs from a herbicide contaminated spray tank, had totally recovered following a single application of Bridgeway. As the agronomist put it, "it was nothing short of a miracle." The herbicide damage was so severe that some of the beet didn't pull through, but in others, Bridgeway had stimulated a new crown to grow. That crop went on to produce larger beet that weighed in 16% heavier than the undamaged beet in the rest of the field, with the same sugar levels.

Eighteen months on, trial upon trial later, working closely with growers and agronomists to really put Bridgeway through its paces, and we are certain that feeding a crop amino acids in-season, not only improves plant health but can produce fitter plants more capable of reaching their yield potential. Deepening our understanding of plant

pathology and biochemistry underpins this belief.

What are amino acid biostimulants and why do they matter?

Biostimulants are incremental technologies to improve yield by improving plant health. They are substances with the exception of nutrients and pesticides, that have the capacity to modify the physiological processes of plants in a way that provides potential benefits to growth, development and relief from stress.

Amino acids are the building blocks of all living cells which combine together in infinite variations to produce countless different proteins critical for healthy growth and development. These proteins play a vital role in virtually every process within the plant – structural components of plant tissue; metabolic enzymes and stimulation; nutrient transport, the list goes on.

Under ideal conditions plants synthesise all 18 L-amino acids they require, which they manufacture from the raw materials carbon and oxygen in the air, hydrogen from water and nitrogen from the soil. Plants therefore depend hugely on soil nutrients.

As nitrate / ammonium is one of the main elements of proteins, ag systems use nitrogen / ammonium fertilisers to replenish nutrients in the soil and aid plants in generating the needed proteins. However, these crucial raw materials can become limiting, particularly as nitrogen (and water) can either leach away in the soil or become inaccessible to the crop, as we found in many parts of the UK in 2018.

Protein deficiency in plants has huge consequences on plant health which in turn impacts quality and yield. Incapable of creating reserves, as proteins have a finite lifespan, a continuous supply of amino acids must be translated in order for plant growth and development to continue. When the raw materials to produce amino acids become limited or the crop encounters abiotic stress (such as high/low temperatures, drought, flooding, disease/pest attacks, phytotoxicity from crop protection products) amino acid production slows and plants start to break down the proteins they have made to gain the amino acids needed to speed up recovery and repair. This occurs because the self-production of amino acids is extremely energy expensive and it is much more efficient to self-cannibalise than it is to synthesise amino acids from scratch.

Feeding the crop additional L-amino acids via the roots or leaf tissue in-season before, during or after a stress event ensures the plant has the necessary building blocks to prevent self-destruction and aid repair.



Herbicide damaged sugar beet almost died.



Sugar beet recovering 15 days after application of 2.0 l/ha Bridgeway.

So, what do these amino acids do?

1. Stress defence - During periods of abiotic stress plants increase production of L-Proline to help reduce the effect and speed up recovery time. It primarily strengthens the cell wall and resistance to weather extremes.
2. Photosynthesis - the most important chemical process of plants - carbon dioxide, water and light energy are synthesized into sugars, which the plant uses as an energy source to power all metabolic processes. This process is highly dependent on the amino acids L-Glycine and L-Glutamic Acid. Both amino acids are key components for chlorophyll production which absorb the light energy for photosynthesis. Increasing these amino acids increases light absorption which increases photosynthesis.
3. Enhance nutrient uptake - by increasing the availability of nutrients to plants. Some nutrients are not available to plants due to their molecular structure, ionic charge etc. The amino acids L-Glycine and L-Glutamic acid are able to bond with these nutrients making them available to the plant. These amino acids are tiny molecules allowing them to easily move through cell membranes. Their ability to bind excess metals means they are also able to reduce metal toxicity in plants.
4. Precursors to hormones and growth factors - L-Tryptophan is involved in rooting, its required in auxin synthesis for growth and development; L-Methionine is a precursor to ethylene which stimulates ripening; L-Arginine is a precursor to cytokinin production involved in cell growth, auxiliary bud growth and leaf senescence.
5. Pollination and fruit formation - one of the most important phases of development and extremely energy intensive due to the very high levels of amino acids required. L-Histidine helps with ripening; L-Proline increases pollen

fertility; L-Lysine, L-Methionine and L-Glutamic Acid increase germination; L-Alanine, L-Valine, and L-Leucine improve fruit / grain quality.

Only as a stress buster?

If crops can synthesise their own amino acids it could be argued that feeding the crop additional amino acids only makes sense to help the crop through a stress scenario.

However, crops also respond with a supplement at the critical stages of plant development, e.g. vegetative growth, start of reproduction, flowering etc. as the production of amino acids required for these critical stages are extremely energy intensive. Diverting that energy to other processes such as photosynthesis, nutrient uptake, grain fill, etc. will improve the metabolic efficiency of the plant and help the crop towards its genetic yield and quality potential.

So why Bridgeway?

For growers looking to maximise the crop's income potential, there is no better source of amino acids. Bridgeway is a plant derived biostimulant produced to food grade quality, containing all 18 L-amino acids required by plants with a ready-to-use source of organic nitrogen.



Bridgeway applied at T1 to healthy crop with no obvious signs of stress. Bridgeway delivered a yield benefit of +0.4 t/ha and a margin benefit of £60/ha.

Feeding a crop Bridgeway guarantees the supply of amino acids for building proteins and provides the most critical amino acids in higher concentration than those biostimulants based on animal sourced protein. For example - 39% higher levels of Glutamic Acid, 33% higher levels of Lysine. Only amino acids sourced from plants can be fully assimilated by crops due to the difference in chemical structure between plant sourced (L-isomer) and animal sourced (D-isomer).

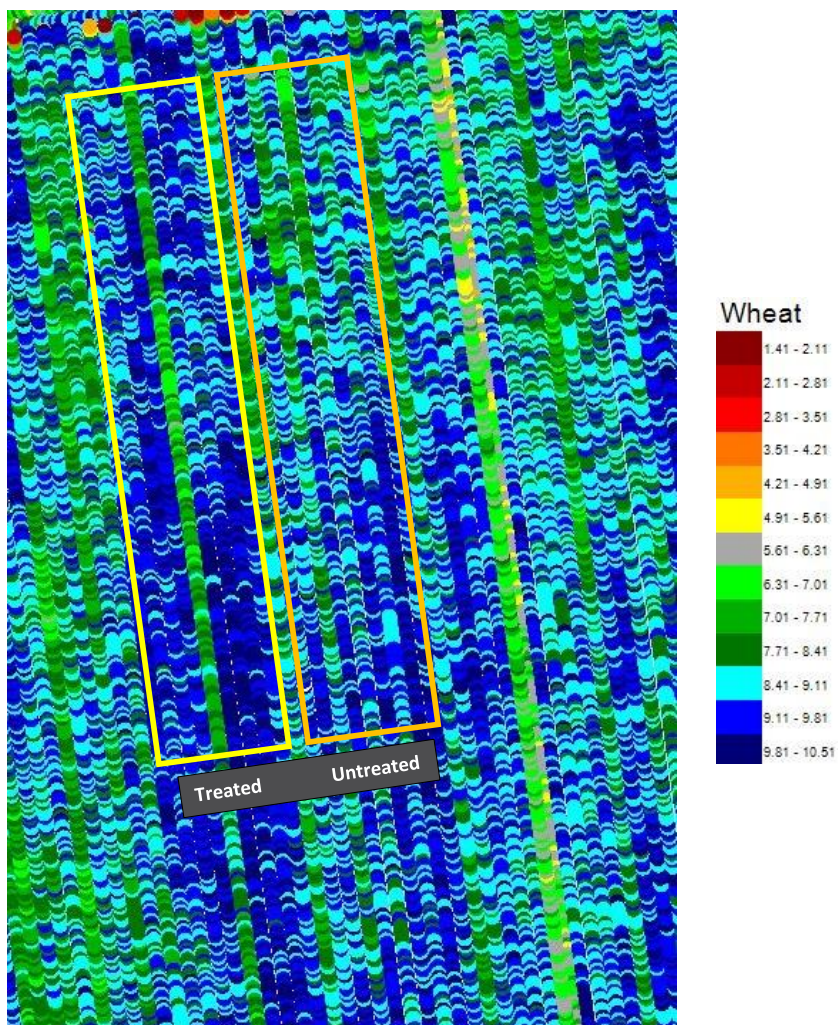
The differences don't end there. Bridgeway is certified GM free and because it is 100% plant sourced it has full backing from the Soil Association and Organic Farmers and Growers Association for use on organic crops throughout the entire life of the crop. Amino acids sourced from animals could be contaminated with heavy metals, salmonella, E.coli and pose a threat to food chain safety. It is for this reason that animal sourced biostimulants on milling wheat were banned in 2017 by NABIM and are restricted in use by a number of organisations. Bridgeway offers not only peace of mind the crop will be able to utilise all the amino acids, it also gives growers freedom to use at any growth stage, in any crop for all end markets.

Delivering results on farm

With an extensive trial and grower programme in a range of crops, it's clear that in the right situation Bridgeway has the potential to add in the region of 3 t/ha to a decent winter wheat crop.

In 2018, two different wheat crops (Relay and Skyfall) each delivered a +2.3 t/ha uplift in yield from applications at T1, T2 and T3. Both crops were exposed to heat and drought stress after the first application of Bridgeway was applied.

Nutrient analysis carried out by the agronomist on the Skyfall throughout the growing period showed the uptake of most macro and micro nutrients was consistently higher in the Bridgeway treated areas. Sugar levels measured using a digital BRIX refractometer were 23-39% higher in their leaves at



Yield map from Skyfall trial shows a clear difference between the tramline treated with Bridgeway (left) and the untreated tramline.

every assessment throughout May and June, indicating a healthy plant that is photosynthesising well and producing the carbohydrates in the leaves and stems which ultimately will be crucial components of yield. Despite the difficult season, the treated crop went on to produce a protein sample of 12.8% versus 11.7% in the untreated.

With a range of yield increases in different crops we are working hard to understand when, where and how best to use Bridgeway to deliver the best value to growers. Look out for the next article in Direct Driller where we'll be sharing the results of our stress and rooting work ongoing at the University of Nottingham and offer in-season advice as spring applications get well underway.

Pushing performance

Yield benefits in a range of crops:

Key takeaways:

- Amino acids are the building blocks of proteins and critical to plant health
- Proteins cannot be stored so a continuous supply of amino acids must be translated for growth and development to continue
- Plants synthesise all 18 L-amino acids in good conditions but stop under abiotic stress or if nitrogen,



Brussel sprout trial harvest, Lincolnshire 2018. Bridgeway treated brussel sprouts (right) showing bigger stalks with more buttons per stalk.

water or air are limiting

- Feeding the crop amino acids in-season avoids self-cannibalisation & threat to yield
- Bridgeway provides all 18 L-amino acids required by plants
- Bridgeway is approved for unrestricted use in all organic crops
- For best results apply ahead of crop stress and maintain applications at the key stages of crop development

For further information please contact stuart.sutherland@interagro.co.uk

Crop

Yield benefit (t/ha)

Winter wheat	+0.3 to +3.0
Winter oilseed rape	+0.25
Winter barley	+0.38 to +0.43
Oats	+0.2
Spring barley	-0.5 to +0.74
Sugar beet	+18%



BASE-UK was established in 2012 and is independent of all businesses or organisations. We provide a forum for members to share information, experience and ideas on conservation agriculture, minimum tillage, direct drilling, cover cropping, integration of livestock and other techniques offering more sustainable agriculture by working in harmony with soils and the wider environment as well as inviting industry experts to speak to members. For membership information go to our website: www.base-uk.co.uk or email our Administrator on rebecca@base-uk.co.uk

We have had a busy Autumn with a couple of BASE-UK member farm walks – thanks to David White in Cambridgeshire and Richard Suddes in Northumberland. We encourage members to hold farm walks and share their experience and knowledge and Rebecca will help arrange these.

David White also liaised with Victor Leforestier, of BASE France and organized a member's trip at the beginning of November which was a great success. This was arranged as a follow up to Victor's talk at our 2018 AGM Conference in February and allowed those of our members who were able to go to see what he was describing. Our thanks

go to Victor who sorted out the logistics in France and Frederic Remy, Emmanuel Bellest and Julien Senez for their generosity in the time taken and knowledge shared with our members. We hope to be able to return the favour and welcome our BASE France colleagues here in the future.

For the first time, BASE-UK attended CropTec at the end of November where we shared a stand with the Direct Driller magazine. This was an interesting experience with a great deal of interest shown in the group and new members joining. It also gave us an opportunity to see some of our existing members who stopped by for a chat. We are

considering partnering up again for LAMMA in January.

In early December we were pleased to welcome Dr Jonathan Lundgren. We held two, day long meetings and a farm walk courtesy of Angus Gowthorpe where the opportunity to discuss pest control using biodiversity was greatly received.

AGM CONFERENCE 2019 - Our next major event is our AGM Conference which is on the 5th and 6th February 2019 at The Haycock Hotel, Wansford, Nr Peterborough. We have a wide variety of speakers over the two days, including – Jackie Stroud, Audrey Litterick, Tom Storr, Simon Cowell, Angus Gowthorpe, Gary Markham. Entry by pre-booked ticket only.

For more information on all our events and activities, past, present and future, please go to our website: www.base-uk.co.uk or contact rebecca@base-uk.co.uk



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DRILL MANUFACTURERS IN FOCUS...



UNIQUE CULTIVATOR DISC REVOLUTIONISING SEEDBED

Employing only a shallow disc cultivator that mixes heavy amounts of trash and crop residue efficiently, has saved cost and timing as well as improved soil condition on an East Riding arable farm without compromising yield.

Guy Shelby farms in partnership with his father Chris and brother David at Benningholme Grange, Skirlaugh, East Yorkshire where all farming operations are scrutinised and developed for maximum efficiency.

The farm is constantly evolving and the family is always looking at ways to reduce input costs without compromising cereal establishment or gross margins. Most recently it has been the cultivations that have come on the radar.

Gone is the conventional approach of using heavy cultivations, and in is the unique Carrier and CrossCutter disc followed by either a 4m Simba drill or 4m Mzuri drill.

Guy Shelby has always maintained that there must be a simpler and cheaper way to establish a cereal crop without compromising gross margins.

"In my opinion conventional strategies are unsustainable and changes will have to be implemented as production costs continue to rise. We have been fairly radical in our approach and only time will tell, but at the moment it is working and we haven't seen establishment compromised or a drop off in our 10t/ha yield average."

Historically he says seedbed preparation on the farm could have involved up to seven passes with various cultivation tools, including a plough, flatlift, two passes with a Cultipress, power harrow, drill and roll all in the same field.

"Our cost of establishment for

second wheat was £120/acre, and even higher where a flatlift was used for the first wheat," he says. "But, this year having reduced cultivations to the Carrier and CrossCutter followed by drill for second wheat, cost is now just £28/acre. This is a huge saving over our 1000 acres of cereals."

The business reached a crossroads when a farming partnership with a neighbour came to an end in 2012 so there was a requirement to reinvest in kit, which also gave the family a chance to consider alternative cultivation strategies.

"We looked at a Simba Express but it was too heavy for our land," says Mr Shelby. "It's also well known that Vaderstad kit is built to last but the discs on our existing Carrier 550 had achieved nearly four seasons to the end of 2017, so needed replacing."

It was while replacement discs were being considered for the Carrier that Mr Shelby watched a video of the CrossCutter disc working, which showed how its unique design for improve mixing of trash and soil at shallow depths on stubbles, cover crops and ploughed land could be achieved.

"Our old discs were worn and we were having to work much deeper to achieve a workable tilth," says Mr Shelby. "This was not good news for blackgrass control."

At Cereals 2017 Mr Shelby then saw the CrossCutter disc and bought a set in time for spring 2018.

This summer was a good test for the Carrier. Despite very hard and dry soils the CrossCutter disc did a great job. The only problem is if it is working on really stony ground the discs can get blocked, he says, but is simple to rectify by reversing a few inches to release the stone.

"Our Carrier is a better tool now



Guy Shelby

than when we first bought it," says Mr Shelby. "We only plough now for vining peas, although the CrossCutter can be used on any soil surface."

Living near the coast it is rare to get harvest started before 11am, he says, and with no labour on hand to cultivate in time for drilling, covering as much land as possible quickly after harvest is essential.

"It's about stubble management," he says. "Sometimes we don't need the CrossCutter and we can go straight in with the Mzuri drill. Often it is possible to use only our stubble rake prior to drilling because our soils have improved so much in recent years through better management."

"We look to achieve shallow cultivations and the CrossCutter straight after harvest is our cultivator of choice now," he says. "It saves a lot of time and it keeps the blackgrass seeds buried. Those that do germinate in the top two inches of top soil are burnt off with glyphosate."

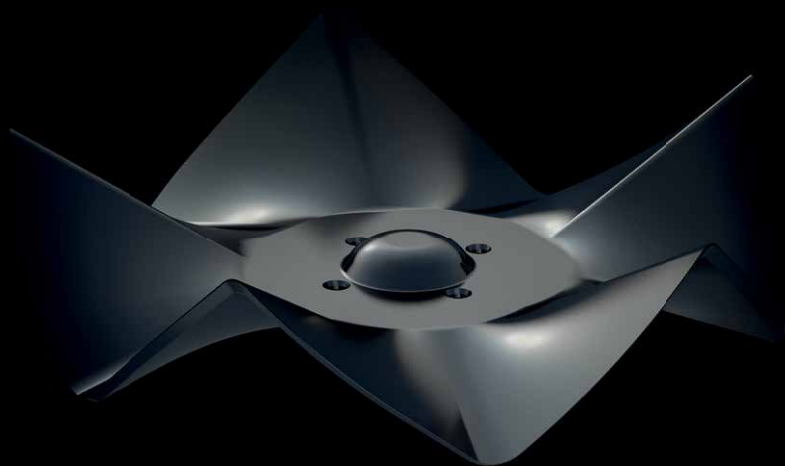


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— **VÄDERSTAD** —



COMPANION CROPPING BOOSTS NO-TILL PROFITS, SOIL HEALTH

By Mark Parker posted on June 1, 2013 | Posted in No-Till Farmer USA

Growing double-crop sunflowers with multiple species has reduced inputs and enhanced primary crop health for Kansas no-tillers Robin and Kelly Griffeth. Double crop sunflowers planted with companion crops have a triple payoff for Jewell, Kan., no-tillers Robin and Kelly Griffeth.

With 2 years of companion cropping under their belts, the Griffeths are harvesting a more profitable sunflower crop, improving their soil and benefitting the subsequent crop in the rotation.

The north-central Kansas farmers follow their hard red winter wheat crop with sunflowers intermixed with as many as nine different companion species, each selected for specific attributes.

Continuous no-tillers since 1995, Robin and his son, Kelly, operate 3,700 acres as they raise corn, soybeans, wheat, grain sorghum and sunflowers. They were already believers in cover crops when an unplanned “experiment” revealed companion-crop potential.

“It was a fluke, really,” Robin says. “I was planting a field of buckwheat in July 2011. I had about 4 acres left and not enough seed to finish. I hate blank spots, so I mixed up some leftover sunflower seed, winter peas, five different clovers, canola, chickling vetch, safflower and a couple of different radishes — just to bulk up the volume enough to finish.”

To their surprise, the sunflowers in the companion mix yielded well, without insecticide, herbicide or additional fertilizer.

“We learned a lot by watching that 4-acre patch and decided this was something we needed to research a little further,” he says.

Designer Seed Mix

Kelly came up with a companion mix for the following year — common vetch, chickling vetch, spring forage peas, winter peas, cowpeas, crimson clover, oilseed radishes, purple-top turnips, buckwheat and sunflowers.

At their normal rate of 21,600 seeds per acre, sunflowers made up only about 10% of the mix. Buckwheat had the largest number of seeds per acre at 64,800, with the other species ranging from 12,500 to 17,000 — for a total of 206,924 seeds per acre.

The sunflower companion mix is planted as soon as possible after harvest, generally late June to early July.

The Griffeths had been planting double-crop sunflowers in 15-inch rows to achieve a quicker canopy. That meant planting at higher populations that depressed yield. What they wanted was a quicker canopy at normal seeding rates.

Using their White 6531 31-row planter — which has Keeton seed firmers and Thompson closing wheels, and is set to 15-inch spacings — they planted sunflowers in 30-inch rows with the



companion mix planted in the centers as a row filler, nitrogen producer and beneficial-insect attractant.

A Great Plains CTA-4000HD drill has also been used to plant the sunflowers and companion mix in 7½-inch rows, and the Griffeths continue to experiment.

In the past 2 years, they've planted nearly 1,000 acres of double-crop sunflowers and companion species with the planter and, last year, drilled 54 acres.

"You have more control with the planter, but we're asking ourselves if we really need a picket-row stand," Kelly says. "As long as we get the desired number of sunflower plants, and they're fairly well dispersed, it seems to work fine — it's more like mimicking Mother Nature."

Seeds are planted 1½ inches deep, the optimum depth for sunflowers.

This year, Robin and Kelly are going to mix all of the seed together — including the sunflowers — in the planter boxes. They don't expect a perfect stand, but believe using a soybean planter plate and optimum air pressure will produce good results.

Controlling Weeds

A burndown herbicide is applied after wheat harvest, and 4 to 5 weeks after emergence, the Griffeths spray Select to control volunteer wheat.

"The companion crop does an excellent job of controlling weeds, and we may get to a point we don't use any herbicide. But this is wheat country, so we have to control volunteer wheat," Robin says. "We may add pearl millet because it will jump up quickly and out-compete weeds, then it's killed by the Select, allowing other species to take over."

Regarding moisture competition in a 25-inch annual-rainfall environment, Robin points out that sunflower roots extend much deeper into the soil than roots of the companion species.

At harvest, the Griffeths use Lucke Manufacturing sunflower pans mounted on a rigid Case IH head, a system that has worked well.

"Most of the taller plants are warm season and have been killed by frost by the time we harvest the sunflowers," Robin says. "If a species is going to cause a harvest problem, it should be left out. The beauty of the flowers we plant is they get 6 or 7 feet tall.

"I wouldn't recommend this with a

dwarf sunflower. You have to choose varieties and companion species wisely."

Reduced Inputs

For the Griffeths, companion planting eliminates the need for an insecticide and a broadleaf herbicide — as well as an 80-pound-per-acre nitrogen application.

Prior to companion cropping, a pesticide was used to control head moths. Now, the companion mix attracts beneficial insects — bees, predator wasps and lady beetles — that have successfully replaced the pesticide.

At a cost of \$15 to \$20 per acre each for the insecticide and herbicide applications, Kelly says the companion-crop seed mix is basically paid for. The entire seed mix, including sunflower seed, costs \$65 per acre — about the same cost as double-crop soybean seed.

The primary profit impact of this comes at harvest time, Robin says.

"Yields are comparable to sunflowers without a companion crop — they're certainly not less," he says. "The real profit advantage is grain quality. The sunflowers have better plant health, with far less insect damage and that gives us better oil content.

"We're paid a premium for high oil content, and with the companion crops, the oil premium has been the highest we've ever received."

Rental Income

In addition to higher yields for grain sorghum and corn following sunflowers, the Griffeths may add to double-crop income by renting companion-cropped fields for winter grazing.

Kelly has taken the lead on identifying plants that contribute positively to the mix.

"You have to do your homework to find out what companion species will work together," he says. "If you look on the Internet, you'll find most of the information comes from gardening Web sites.

"You can find out which species grow together, and those that have a negative impact on each other. It's important to avoid antagonistic combinations. You don't just throw a random mix out there."

The Griffeths have grown double-crop, food-grade buckwheat and believe it's an important component. Kelly says buckwheat makes phosphorus more available for the following crop,

establishes quickly and attracts beneficial insects.

Companion Criteria

There is a wide world of other species from which to choose, Kelly points out.

"All species have to satisfy two criteria," he says. "They have to be compatible with the primary crop, not detrimental.

"And they have to help us accomplish something we're after — quick weed suppression, soil building, nutrient cycling and attracting beneficial insects."

Although they continue to assess species and mixes, Kelly says one thing is clear.

"I'm not sure you can get too much intensity," he says. "If there's been an issue, it's because the mix is not intense enough. We had some maretail pop up here and there, for example, and we felt it was due to the companion stand not being intense enough."

Crop Insurance

Robin and Kelly plan to extend their companion-crop concept to corn this year. It will have to be on double-crop corn, however, since crop insurance will not cover the practice.

"Making a profit is our primary purpose," Robin says. "We take care of cash crops first, and anything we try has to pencil out. We'd love to try companion crops on full-season crops but, from a risk management standpoint, you don't want to make an insurable crop uninsurable."

The Griffeths will plant corn in 30-inch rows with a companion mix of lupins, cowpeas and sunn hemp.

Soil Benefits

The Griffeths also plant cover crops ahead of soybeans — typically cereal rye, oats, safflower and mustard, or other mixes.

Continuous no-till with cover crops makes a positive soil quality impact, says Kelly. In addition to decreased compaction, reduced erosion and increased water efficiency, the Griffeths have measured rising soil organic-matter content.

"We soil sampled a CRP field we've farmed for 3 years," Kelly says. "Organic matter was 3.1% when we took it over and, 3 years later, it was up to 3.5%. That's all from using cover crops and no-till, and I think the companion cropping can have an even bigger impact."

FARMER FOCUS

STEVE LEAR



A Great Year to Start No-Till.....

This autumn has been a good one for progressing into no till. The weather had done any subsoiling that was needed by cracking out the soil to a depth of two foot in places. In late September I was getting a little worried. I had been told that late drilling doesn't work very well with no-till. The fields hadn't greened up at all and I was loathed to drill anything until we had killed off a flush of blackgrass and volunteers. Luckily for us mother nature was on our side and we have been able to establish crops into unmoved soils into November after a good flush in mid-October. We have a large acreage of hybrid barley in the ground which looks well but will need an early dose of nitrogen when the winter ends to get it going in the early spring. Our wheat all looks very well. Since going to no till, we have upped the seed rates in winter wheat. I may have put on a little too much in some fields as we have seen very good establishment this year, in fact its probably better establishment compared to our old conventional system. On all our cereals

we have put a small amount of liquid phosphate down with the seed to help improve rooting. I would in the future like to find a biological product to do this job. Instead of applying fresh nutrients into the soil, it may be better to apply a biological product that could help break the chemical bonds in the soil or help the plants take up the nutrients more effectively. I'm on the search for such a product and will carry a few trials out next year. We have only used a minimal amount of slug pellets on cold north facing slopes. I imagine that the dry summer has meant a huge reduction in the slug populations on our ground. On top of this I have kept with my plan to not use any insecticides on the farm. I hope I can continue to do this when we lose Deter seed dressing. Even though the weather has been ideal for them, we only had a minimal number of aphids arrive on our cereal crops, I'm beginning to think they don't like landing in stubbles but I may still be proved wrong.

The wheat variety that we have chosen this year is Nelson. It is a high-grade German milling wheat. It also has shown to perform well in organic systems. I am hoping that we can reduce

the number of fungicide passes we need in the crop to help protect soil microbes better. It will be interesting to find out if its high untreated yield is due to its symbiotic relationship with mycorrhizal fungi or the fact that it has a huge flag leaf.

We have also drilled winter beans this year, which is a first for me. We sprayed out a four-year grass and clover lay and direct drilled the beans at the beginning of November. The white clover has remained in the crop as its fairly resistant to Glyphosate and we will use it as a companion crop for the beans. I'm hoping the two species will fix a lot of Nitrogen for the following wheat crop and improve the structure of the field as well as suppressing any weeds that come in the spring.

We have reseeded some pasture land this autumn with great success. I have read up on how they do this in New Zealand. The pastures were grazed down very tight and no fertilizer was applied to the fields. This was to limit competition from the existing sward. We direct drilled the fields straight into the existing pasture using a mix of tetraploids and diploids at about a



Beans went in at a depth of 3 inches



Grass seed in the T-Slot



Minimum ground disturbance when drilling into ex pasture land



Drilling Winter beans into a four year grass and clover ley

2/3rds rate. The cattle were left on the pasture until the new grass had chitted and was at risk of being pulled out of the soil (about 2 weeks later, but I think we could extend that). The cattle are allowed to graze as soon as the roots of the new grass has established and it's not possible to pull new plants out the ground. I'm interested in establishing more diverse pastures next spring and

using some herbal plants. With a more varied root depth I think we will be able to pull nutrients up from deeper, increase soil biology and keep some growth in the fields throughout the drier months.

With no cultivation to do we have been able to spend more time on sampling soils in the autumn. I'm starting to carry out a sort of soil benchmarking

of our soils. As a bench mark, I am testing soil that has been in a natural cycle for many years. This comes from either under hedges or in small wooded areas. I'm hoping this will give me some figures to aim for in terms of microbial activity and organic matter in the soil. My samples are tested by NRM laboratories who offer a package called the 'Soil Health Suite'. It contains all the usual tests as well as a CO2 burst test for soil microbes, an organic matter test and a soil textural classification. As well as these I am also slowly getting around the farm and carrying out worm counts, infiltration tests and slake tests. This will help to see where we have improved soils and where we need to do more work.

As well as the farm, I am still expanding my knowledge of how the soil works. It seemed a sensible step to become a member of BASE. I'm looking forward to meeting members and finding out how they have improved their farms and if there is anything I can bring back home from the meetings, I am sure there will be. Since joining I have watched the presentation on the BASE UK website from Dr Kristine Nichols, it's worth the membership fee alone.

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GRAZING CROPPED LAND

The almost forgotten technique in the UK of grazing cereals is something being widely practiced across Australia in areas with widely varying rainfall levels. The Australian Grain Research and Development Council have produced a report titled Grain and Graze which sets out to evaluate the advantages and disadvantages of grazing a range of cash crops. We begin serializing this report over forth coming issues to explore what is currently an untapped resource.

In Direct Driller Issue 3 we started looking at the potential opportunities of grazing winter crops. One of the greatest downsides is the risk of potential reduction in grain production and value due to grazing. This is where we pick up our content on grazing winter crops.

The Possible Costs (the downside)

The greatest downside risk is the potential reduction in grain production and value due to grazing. Results from Grain and Graze and other experiments show a wide range of yield and quality responses to grazing, from large reductions in grain yield to no yield losses or even increases in yield.

<Header 2> Reduction in grain yield

Grain yield data from 2004 to 2013 was collected across 53 cereal trials and 246 measurements in Western Australia, South Australia and Victoria where a grazed and ungrazed comparison could be measured (figure 1). This included wheat, barley, triticale and oats. The results also include treatments where grazing was less than ideal, including grazing after stem elongation and when crops were under stress. These extreme treatments were imposed to appreciate the size of the yield and quality loss under adverse conditions.

Figure 1 highlights several key points:

- Cereal grain yield declined under grazing most of the time crops were grazed (78%), although the severity of the decline varied. The most common result was a yield decline of less than 250 kg/ha (25% of cases), with yield loss of between 250 kg/ha and 500

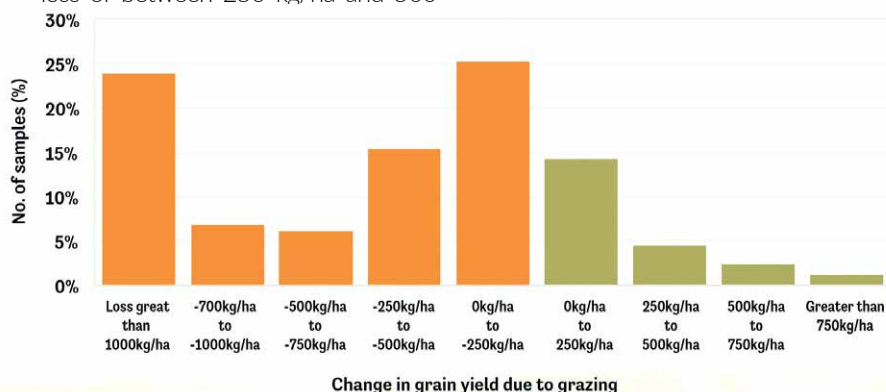


Figure 1: Change in cereal grain yield due to grazing.

Factor	Effect
Growth stage of crop at end of grazing	Grazing after growth stage 30 may remove elongating grain ears and leave insufficient time for recovery before flowering.
Stressful environmental conditions after grazing and before flowering	Heat, moisture stress or waterlogging can hamper crop recovery and result in a loss of tillers and grains per ear.
Intensity and duration of grazing	Grazing that removes too much leaf may hamper adequate crop recovery reducing the potential for complete grain fill.
Variety maturity pattern too long for the growing environment	Grazing will delay maturity and may expose ripening crop to heat and moisture stress.

Table 1: Important factors observed to adversely affect grain yield

kg/ha occurring a further 15% of the time.

- Increases in grain yield were recorded in 22% of cases. The most common increase was up to 250 kg/ha although some larger gains were also recorded. The main reasons for the gains were attributed to reductions in lodging and less leaf disease, both a consequence of the removal of early growth by grazing.
- Large losses in grain yield were recorded (24% of cases). Four factors are believed to contribute to the large yield decline (table 2).

Canola

Grain data for grazed canola was limited. Most of the information was collected from Southern Victoria when the crop was sown at the conventional sowing time (late April to early May). Dry matter production was generally lower than cereals sown at

the same time and the crop was slower to recover from grazing. This resulted in severe yield penalties.

Best practice sowing guidelines for canola are to sow in Late March to early April, but this may be difficult to achieve in some areas because of stubble burning restrictions and weed control. However, the availability of new canola varieties with strong winter habit provides the opportunity to sow by taking advantage of out of season rainfall (October through to February), where the crop is treated like a brassica fodder for grazing before being locked up and taken through for grain.

<header 2> Changes to grain quality

Grazing resulted in a variable response to cereal grain quality. In some trials grazing improved grain quality characteristics, in other trials grain quality declined. The general conclusions from the spread in results are discussed.

Protein Grazing did not affect the average grain protein in wheat but did with barley. Of the 64 wheat results examined, the average change in wheat protein from grazing was -0.1%, with a similar number of increases in protein recorded as decreases (figure 2).

The grain protein response to grazing for barley was different, with grazing more commonly resulting in a decline in grain protein (65% of the time). The average decrease across all trials for barley was 0.3% (figure 3).

The reasons for the decline in grain protein with grazed barley is not obvious. The results used in the analysis were

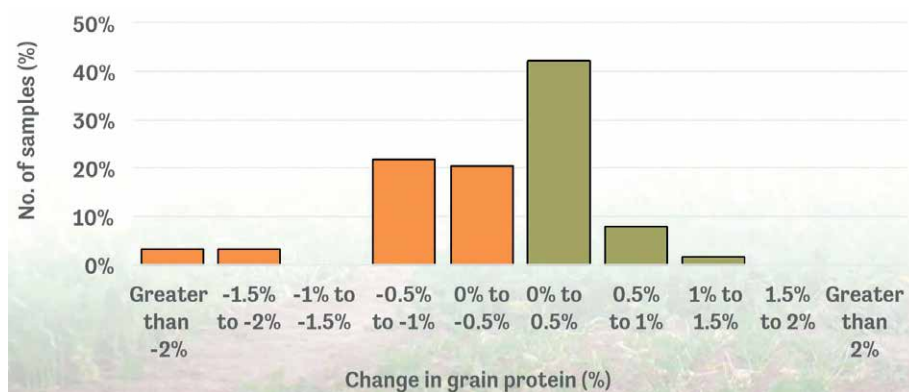


Figure 2: Change in grain protein for grazed wheat compared to ungrazed wheat (data from 64 comparisons).

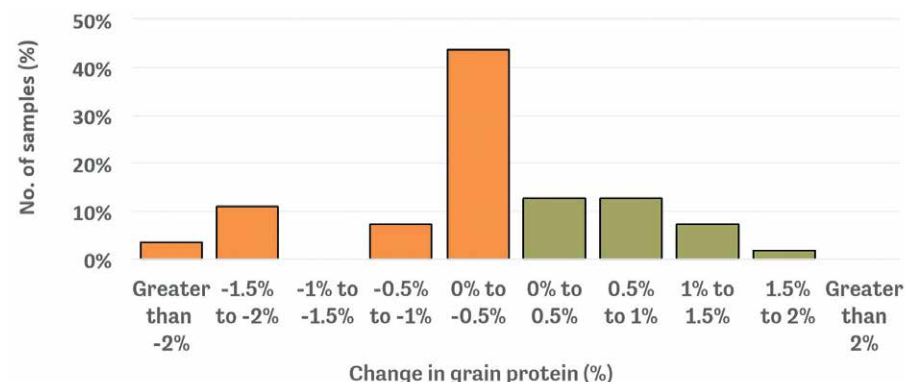


Figure 3: Change in grain protein for grazed barley compared to ungrazed barley (data from 55 comparisons).

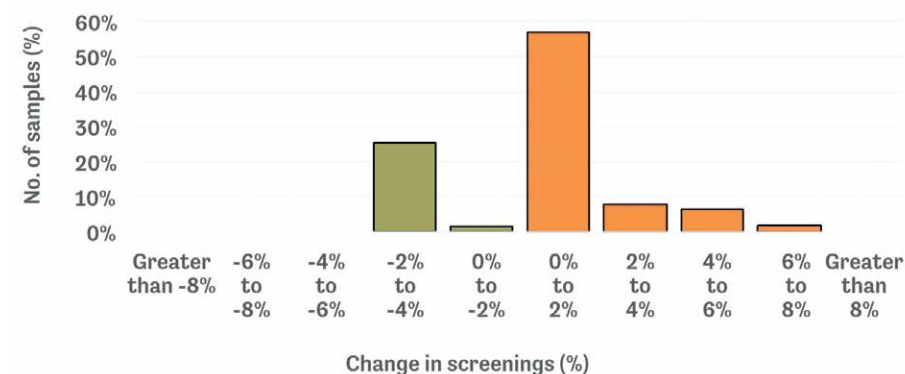


Figure 4: Change in screenings for wheat due to grazing (63 comparisons).

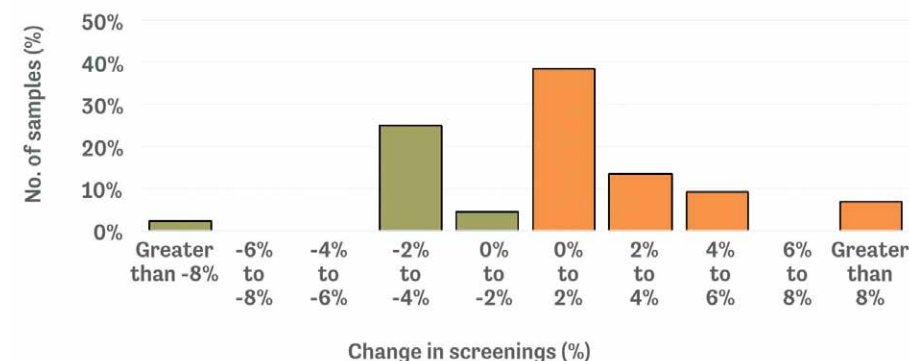


Figure 5: Change in screenings for barley due to grazing (44 comparisons).

collected across many years, using different varieties, nitrogen applications and time of grazing. This makes it difficult to identifying the possible reasons for changes in grain protein. The only loose association from

the information is between grain yield and protein. It appears if grain yield is increased because of grazing, which happened in 40% of all the barley trials, then grain protein decreased (i.e. was diluted).

Grain size

Grain size in wheat and barley was generally not affected by grazing. Of the 54 comparisons with wheat and 42 comparisons with barley, slightly more than half the observations showed a reduction in grain size due to grazing. The average reduction in wheat was 1% and 2% for barley. The limited (less than 10) observations of grain size for triticale and oats showed similar responses to grazing as wheat.

Screenings

Screenings increased slightly for both wheat and barley as a result of grazing. More than 73% of wheat and 68% of barley comparisons showed an increase in screenings compared to no grazing (figures 4 & 5). The average increase in screenings for wheat was 0.9% and 1.4% for barley. There was a slight correlation between increasing screenings and a reduction in yield after grazing.

Calculating the value of grazing crops

Calculating the value from grazing winter crops can be challenging because while there are immediate benefits through feed for livestock, the flow on effects are often more difficult to quantify. These flow on effects may include potential grain yield loss from grazing, building a 'feed wedge' because pastures can be spelled and making different livestock management decisions. The gains are realised within the farming system and not simply by comparing the potential loss of grain yield with the livestock gain when the crop is grazed.

Modelling undertaken by the CSIRO2 would suggest the potential benefits to whole farm profitability are very significant, in the order of AUS\$100/ha to AUS\$200/ha. Attention to variety selection, early sowing, adopting best grazing practice and increasing stocking rate are all required to achieve this potential.

Individual farm considerations such as weed and disease issues, chances of favourable climatic conditions to enable early sowing, adequate farm infrastructure and cash flow to run more livestock and the manager's position on risk may temper these potential benefits.

GRAZING CROPS CASE STUDY

Profile

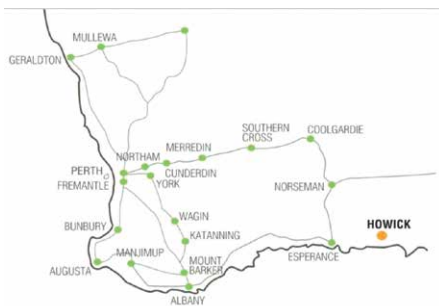
Fowler Family (Andrew & Marie, Simon & Robyn, Tim & Kath, Richard & Elaine)

Location: 'Chilwell' Howick, East Esperance, Western Australia

Farm Size: 16,500 ha Annual Rainfall: 500 mm GSR

Soil Type: Mainly duplex sand over clay, with depth of sand varying from a few inches to a few feet Enterprises:

Cropping 10,000 ha **Grazing** 6,500 ha



The Fowler family from East Esperance in Western Australia started grazing crops in 2008 as a trial before fully incorporating into their farming system in 2010.

In 2011 they cropped 10,000 ha of wheat,

barley and canola, of which more than half of that was grazed.

Andrew Fowler said grazing crops had delivered a major lift in the profit of their operation and that it was one of the best innovations they had implemented on the farm.

"We first tried it to make the pasture phase of our rotation more profitable and comparable with the cropping phase," Andrew said.

"Previously we were looking at about \$200/ha gross profit for livestock which wasn't much when we compared it to cropping, which was about \$500/ha.

net profit by \$500,000 by growing an extra 1,000ha of crop and retaining their livestock numbers.

"Grazing crops is a really important tool in matching the supply of feed to livestock demand, and it has helped the farming business to harness the synergies between livestock and crops" Andrew said.

"As a result we have had some great benefits with liveweight gains, higher stocking rates, cost savings, crop management advantages and more: all with little impact on crop yields at harvest".

Benefits of grazing crops

"Grazing crops significantly reduces the levels of disease in barley (especially powdery mildew) when compared with ungrazed crops, which eliminates the need for an early fungicide spray," Andrew said.

"In our canola crops, the height of the crop is shortened which makes swathing and harvesting a lot easier. In 2010, the height of the crop dropped by a foot as a result of grazing." Yield and quality are not compromised as a result of grazing. In 2010 the Fowlers' highest yielding paddocks were grazed, a wheat heat paddock went 4.7 t/ha and a grazed canola paddock yielded 2.1t/ha.

The quality was excellent with 45% oil and 0.6% admixture. Andrew said an additional benefit is less grain is required for supplementary feeding. We wouldn't be able to maintain our livestock numbers if we didn't graze our crops. "We would have to feedlot the sheep and cattle, or decrease our numbers which would reduce the profitability of our pasture phase and this was the main reason for heading down this path in the first place".

The Fowlers have had excellent live weight gains from grazing crops. For sheep, they average about 300 grams/head/day and 1.8 kilograms/head/day for cattle. In 2011, their drop of crossbred

"We needed to lift our stocking rate to increase our return per hectare to make grazing worthwhile, as well as to help recover some of the fixed

costs associated with livestock and maintaining pasture paddocks."

By using grazing crops, the Fowlers have now managed to lift the pasture phase to \$350/ha gross profit and nearly double their stocking rate from 10 DSE (dry sheep equivalent) to 18 DSE.

In 2010 they increased their



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Merino White Suffolk lambs only spent five days grazing pasture before the first draft was sold on 8th August at 18.1 kg for \$118 a head. (The rest of their lives were spent grazing crops.) The ewes lambed in stubble before grazing a barley crop at the three leaf stage. The lambs were weaned at six weeks, the ewes were sold, and the lambs continued to graze crops.



Sheep in canola – Sheep happily grazing in the canola.

Challenges

Andrew said at the start, the hardest part was to open the gate and let the stock into a good looking crop, but he was amazed how quickly the crop recovered.

Other challenges the Fowlers have faced and, that Andrew stressed, were very important for the system to work, include:

- the early seeding of crops
- good weed control
- a good rotation.
- providing ad-lib straw for livestock, and
- not over-grazing the crops, with the best results achieved if there is some biomass left after grazing.

Crop stages and management

Livestock are removed from crops at the first hollow stem (around Zadocks GS 30) in cereals, and with canola, stock are removed when the buds are about 10cm high and there are a few leaves left.

"The best results are achieved when you don't take all the biomass away – you can graze to the white line (when there is no green left) but we have found that the crop is a lot slower to recover if you do this," Andrew said.

They have found the early sown crops handle grazing well, but the flowering date of the later sown crops is pushed back a bit too far (and the yield affected) without careful grazing.

The Fowlers finish grazing most paddocks by end-July and the latest date is early-August. After livestock are removed, the Fowlers immediately spray with a Nitrogen (N) application. Once a new leaf has fully emerged, barley crops are sprayed with a broadleaf and powdery mildew spray, and Roundup Ready Canola is sprayed (being careful to manage withholding periods if crops are to be grazed post-spraying). The Fowlers admit the big advantage for them is the lack of frost occurrences in the region, which allows their crops to recover quickly.

Pasture tips

The Fowlers continue to strategically rest and graze their pasture paddocks while grazing crops.

"We don't lock up our pasture paddocks otherwise the cape weed gets away on us," Andrew said.

"If we continue to use our pastures, we find that it increases the quality and quantity of feed for August when we start full time grazing.

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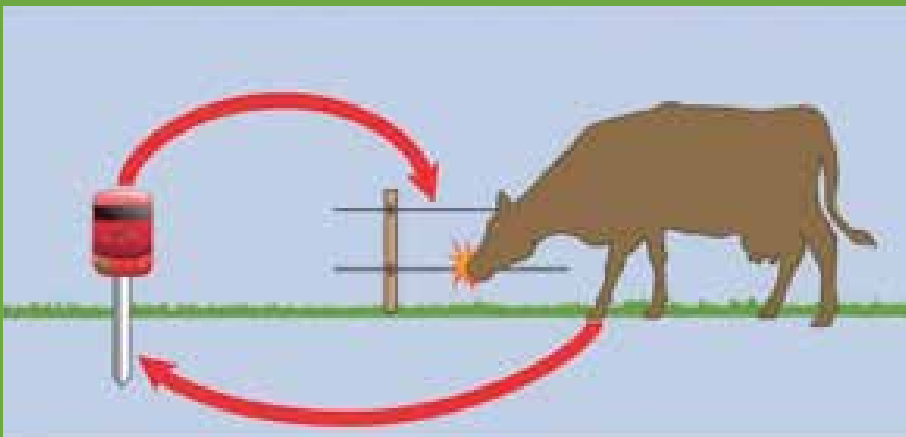
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USING TEMPORARY ELECTRIC FENCING TO GRAZE CROPS OR COVER CROPS

The main thing to understand is that an electric fence is a psychological barrier for animals. The initial electric shock they receive means they are deterred from approaching the fence again. Therefore, how a fence is erected and the speed with which it can be moved is critical when consider what is important in terms of using them to help graze crops. In this guide we will with the help of Rappa introduce the elements of a fence and what you would need to be able to graze your crops (so you just need to add the animals).



As you are already probably aware, an electric fence is made from three elements:

Energiser - generates a regular pulses of electrical current

Wire - conducts the current

Earth - returns the current back to the energiser.

Energisers

The energiser converts electricity from mains supply or batteries into high voltage pulses of electric current at one second intervals, that travels along the fence. The type of energiser you need depends on how close the fence is to a mains electricity supply, the fence length and the type of animals you want to control.

Wire

There are many variations of wire suitable for electric fencing.

- **Steel wire**, either single or multi-stranded, is strong, durable and highly effective at conducting electricity, so the animal receives a greater shock when touching the fence. Steel is heavier than other alternatives, and is best used in permanent or semi-

permanent fencing where you need good tension on the wire.

- **Polywire** is lighter than steel. It is made from UV-stabilised plastic twine with three or more strands of stainless steel wire woven into it. Polywire is designed for temporary fencing and strip-grazing, although the more substantial polyrope can be used for permanent fences.
- **Polytape** and polybraid consist of stainless steel wires and plastic strands woven into a ribbon, available in a range of widths and colours that can be used for permanent and temporary fencing. Both are highly visible, but can be vulnerable in high winds..

Wire Reels

A reel allows you to unroll the fence wire evenly without creating potentially damaging kinks, then roll it up again neatly for reuse. By locking firmly onto a reel post, the reel keeps the fence wire taut. We offer two kinds of reels:

- **Rappa Reel** - for use with our Rappa Fencing Machines

- **Hand Reel** - for manual fencing

Posts

Permanent fences use timber posts to support the wire, while temporary fences rely on metal or plastic posts, available in different heights and spacings, depending on the stock you want to fence. In addition, anchor posts are used for temporary fencing in the corners or at the beginning of a fence, and help keep tension on the fence wire. Temporary fences also require a reel post at the end to hold surplus wire and keep the line taut.

Insulators

Insulators keep the fence wire from touching the supporting post or stake, preventing electricity leaking back to the ground. Anchor or end-strain insulators also take the strain of the wire at the end of the fence line or at corners. Polyposts are made of non-conductive plastic therefore separate insulators are not required.

Good quality insulators should be smooth and dry off easily to prevent moisture collecting in nooks or cracks causing current to leak, creating an 'arc'. Arcing, which produces a regular clicking sound, reduces the effectiveness of the fence.

Offset insulators give a longer life to permanent fencing by holding the electric wire a short distance away from a new or existing permanent fence, stopping animals causing damage by biting, leaning or rubbing.

Earth stakes

Earth stakes are inserted into the ground and attached to the energiser. They ensure the power returns through the ground and back to the

energiser when an animal completes the circuit by touching the fence.

Fence Tester

All electric fences need regular maintenance. You should regularly measure the power on the fence lines using a fence tester - or voltmeter - that will help locate any problem areas where power is leaking away.

Electric fencing machines

While fences can be put up manually, there is certainly skill involved. Automating the process with a machine, will help keep the wire taught and visible and reduce the chance of accidental grounding.

Electric fencing machines, also known as winders, are used to erect and dismantle up to four lines of fence wire quickly and efficiently, perfect for strip or cell grazing where fences are moved frequently - a typical 600m electric fence can be put up in 20 minutes and dismantled in 10. Rappa's fence winders have been developed and built in the UK for the last 40 years, and now include a range of six machines, from manual-push barrow winders for small or inaccessible areas, to larger models that fit onto an ATV or RTV - from human to horse power! The RTV Winder is designed to pick-up on the left hand side so the fence can be dismantled without leaving the seat of the cab. The largest in the range, the Trailer Winder, can fence up to 5km in one hit, again this can be specified to pick-up the fence on either the left hand or right hand side. A complete range of fence packs have been developed to compliment the fencing machines.

Installing an earth

First, work out how many earth stakes you need. Larger fence energisers exerting more power, or longer fence lines with higher leakage, require substantially more earthing. As a rule aim for 1 metre of earth rod for every joule of energy, ie. a 5 joule energiser will require 5 metres of earthing.

You need to link your earth stakes together with underground cable, which is then connected to the energiser's earth terminal. Your earth



stakes should be at least 4 metres apart, and kept well away from domestic earth systems, and at least 10 metres distance from any other earth installations, such as those used by telephone or electricity supply companies.

Never use steel water pipes or steel-framed buildings as an earth. You also need to place your earth system in a consistently damp site. In areas where the soil is very dry, or there is a lot of sand, peat, gravel, snow or frozen ground, you can boost the efficiency of the stake by watering the ground in dry weather or increasing the number of earth stakes.

You can also run an earth return wire parallel to the fence line, and connect it to earth stakes at regular intervals. Bear in mind that an earth system installed in winter, which is adequate for winter conditions, may not be suitable for summer; this may explain any substantial loss in power on your electric fencing over the summer months.

Safety in electric fencing (the things you should and shouldn't do)

Properly installed and maintained, electric fencing is safe for humans and animals. However, you must adhere to the following:

- Never electrify barbed wire or any other material that could entangle an animal or person.
- Never attach more than one energiser to a fence. Maintain a gap of at least 2 metres between separate electric fences.
- Put up warning signs at intervals of no more than 10 metres on any electric fence installed along a public path or highway, or at any other point where people may encounter the fence.
- Where your fence intersects a footpath or highway, you must incorporate a non-electrified gate or stile to cross the fence.
- Never install connecting leads (underground cable) in the same conduit as mains supply wiring, communication cables, or data cables.
- Avoid running electric fences parallel with overhead power or communication lines, as it may induce a dangerously high voltage on the fence line. When crossing under power lines do so at right angles and make sure the fence height doesn't exceed 2 metres.
- Install a mains fence energiser under cover, near a mains supply. Make sure it is out of reach of children, and away from flammable materials.

WATER FOCUS

AFFINITY WATER



Soil and Water

Our population is growing and so is the demand for food, highlighting the importance of farming to us all. This growing population will also need more water, especially in the south-east of England. The company I work for, Affinity Water, supplies water in an area already under 'serious water-stress' so it is vital that we manage our water resources, from source to tap, in the most sustainable way possible.

The obvious, but often overlooked, fact about drinking water in the UK is that every drop has been sourced from the natural environment in which we all live. We must abstract water from an environment that is also being used for food production, industry and human habitation. In the UK, agriculture is the dominant land use in many of the catchments used for public water supply. Whether you farm on the banks of the Thames or the tops of the Downs; every piece of land, every farm in this country sits within a water catchment. Therefore, what happens on farm and in the field is of interest to us in the water industry and we want to help farmers make positive choices for their farm business and the water

environment.

As a reader of Direct Driller you are clearly interested in soil health and value your most important asset, the soil. Improving soil health, although difficult to measure in metric terms, is something you are working towards and see value in. What impresses me about no-till farmers is not only the desire to improve soil health but also the innovative ways many of you are farming. Innovation such as reducing inputs, trialling companion cropping and introducing novel crops into your rotations are a few examples. Many of these innovations will contribute towards a sustainable, resilient farm business but can also help the water environment by reducing soil run-off



and losses of inputs to water such as pesticides and nutrients. More research is needed to quantify these benefits to the water environment at a farm and catchment scale, particularly in a UK context, but the perceived wisdom is that healthy soil will lead to healthy water.

Affinity Water, like many other water companies in the UK, have a catchment management team who are working with farmers and other land managers to solve water quality challenges at source. I am sure you have heard of (or are even part of) one of the many water company metaldehyde schemes across the country. Working on metaldehyde reduction in catchments has been an important learning curve for us and has helped us get to know many farmers across our patch and find workable solutions to this problem.

Another important aspect of our work is investigating what methods can be used on farm to reduce nitrate leaching to water. We have been investigating the effectiveness of cover crops at reducing nitrate leaching in our drinking water catchments. Cover crops are well known for capturing excess nitrate in the soil but also have many other benefits to the soil and the wider environment. The trial, now into its third year, has tested different cover crop mixes to assess not only the benefits to the soil but also how much nitrate is captured by the cover





the rivers and groundwaters that rely on rainfall for their function. As an industry we are completely reliant on rainfall. We can't affect how much water falls from the sky but the next best thing we can influence is the soil that covers our catchments. It is generally acknowledged that no-till soils have better water infiltration than a tilled soil so one would assume that if a greater area of arable land in our catchments was under no-till then we have greater potential for water recharge into our aquifers. This hypothesis needs to be tested and we are planning to research this topic over the coming years.

I hope to continue to contribute articles to Direct Driller and will keep you informed of any developments in our research into soil health and the water environment. If you have any questions or ideas for our catchment management work I'd be happy to hear from you. E-mail: shaun.dowman@affinitywater.co.uk

crop. The results are promising and has confirmed to us that cover crops are effective at capturing nitrate. So convinced are we by the benefits of cover cropping that we are planning

to incentivise farmers to grow cover crops in areas where we have a nitrate leaching problem.

The soil is the interface between the rain that falls from the sky and

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WATER FOCUS

THAMES WATER



Creating a Smarter Water Catchment in the Evenlode - Thames Water No Till & Cover Crop trial

Thames Water has recently started a No Till and Cover Crop trial in the Evenlode river catchment as part of its 'Smarter Water Catchments' initiative. The company's work, alongside colleagues from Atkins and Natural England, is helping to encourage water sensitive farming across the Evenlode catchment and to reduce run-off of phosphorus from farms and fields into local watercourses. The project has a number of components in addition to the No Till trial, including an agri-environment grant scheme and advice service.

The River Evenlode catchment lies to the west of Oxford and is in the Thames river basin, partly within the Cotswolds AONB, with the river flowing from Moreton-in-Marsh to Eynsham over a distance of more than 75km.

Thames Water is particularly interested in exploring whether a 'no till' approach reduces the loss of soil and, in particular, phosphorus, to watercourses, while improving soil health. The company is also interested in whether the approach can increase farm profitability and efficiency.

The trial started in September 2018 and is designed to run for five years, with research support from Innovative Farmers. The trial is farmer-led, allowing participants to test additional topics such as soil health, nutrient application and cost vs yield.

Thames Water is supporting its trial farmers in exploring the challenges and benefits of the no till and cover crop approach by offering funding for machinery costs and cover crop seed provision for the no till fields. The aim of this is to remove some of the risk involved in trialling the approach.

Field scale soil and water quality monitoring has commenced and will continue throughout the trial. The company looks forward to reporting on some of the initial results from this



project in future publications. If the trial is successful, Thames Water will be looking to work with other farmers and land managers to promote this approach in other parts of the Thames River Basin.

For more information, please contact the Evenlode project team from Atkins and Natural England. Jay Neale, Atkins

(jay.neale@atkinsglobal.com) or Sarah Olney, Natural England (sarah.olney@naturalengland.org.uk)



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SOIL FERTILITY SERVICES

It was in 2002 that I first wrote an article outlining: 'The need for' and 'Benefit of having' a good population of mycorrhizal fungi in your soil. That is of course still true but it is not the most important of the life in your soil; so what is?

Of course there may not be any one type of life that is most important, but you will be well aware there are many that can be important but for the wrong reasons. For example soil micro-organisms that are pathogenic to the crop you want to grow - you could argue these are the most important because of the damage they can do e.g. Take-all, Fusarium, Clubroot, Rhizoctonia, Scab, Cavity spot, Rust, Eye spot and others all determined to eat or damage your crop and that is without mentioning the insects that munch on the leaves.

What if we stay with the beneficials e.g. earthworms; there are three main species of these and they should be counted as V.I.M. (very important members), but it is none of these; in regular arable cropping it is the beneficial micro-organisms that will live in, on and around your plant; protecting it from the pathogens, feeding it from the soil reserves and from the atmosphere, providing such things as nitrogen, phosphate and trace elements.

If you create the correct conditions, the mycorrhizae will inhabit your soil, creating a 'cobweb effect' across the whole area and provide some minerals to your crop. They will not protect it from the soil dwelling pathogens.

Beneficial micro-organisms are everywhere, and they are needed by

all living organisms on earth. They live symbiotically with plants, animals, and us. If not for these little factories, we would not be able to digest our food and get the vast range of nutrients we require daily. They also defend their host by producing certain antibiotics or simply blocking pathogens away from infection. It is a cornerstone of a healthy immune system. The same goes for the plants; the topsoil is the digestive tract which will provide roots with nutrients that the plant requires, at the time it needs it.

Some of the micro-organisms will protect the host in exchange for sugary exudates from roots, so it acts as the immune system of the plant. To make sure soil is functioning properly, ensuring favourable soil conditions are a must. Additionally, it won't be any good if we don't have adequate numbers of these beneficial micro-organisms that will carry out these specific functions, so inoculating soil at key stages will



ensure that the plant gets maximum benefit.

The soil is a living breathing organism and as such, just like any other living creature, it needs air, water and food in that order. However, there are also plenty of anaerobic micro-organisms that are, for the most part, pathogenic and not what you want to encourage.

The most important microbes in any living thing, including you and me, are the ones you can't see but you can smell them. When your soil smells sweet, that is the geosmin wafting their aroma and is an indication of a healthy soil.

This life in your soil is a constant battle ground, as one army becomes dominant this is then attacked by





Soil Fertility Services Limited Cereals Plots 2018

Untreated : Conventional Winter Wheat - 300kg nitrogen plus full fungicides, herbicides and every other 'cides'.



Treated plot : Biological Nutrition Programme for Winter Wheat - NO nitrogen, NO fungicides other 'cides' as required.



another and depending on the host plant, may be defeated. If the winner is a pathogen, then your crop will suffer, so now it becomes obvious we need to invest in the beneficials and that means feeding them and adding to their numbers to help them outcompete the pathogens. Bearing in mind it is a constantly changing environment, with plant growth stages affecting the food source for these microbes, which in turn affects the types of these mini bugs, that is why we have now introduced a complete biological programme.

It starts before you plant your next crop, feeding your soil with beneficial microbes in a unique food source. This will allow the beneficial microbes to inhabit the rhizosphere, providing nutrition to your plants with specialist root development enzymes. The inclusion of a range of 'phosphobacters' means your plants get their phosphate requirement from your own 'locked up' phosphate reserves. A pre-drilling application of Bio-Start is also preparing your soil for the nitrogen-fixing bacteria in the spring. It is all about priming your soil's 'microbial army' for the spring growth surge.

In spring we will once again feed your soil's 'army' and will include a range of nitrogen-fixing organisms. Depending on the type of and the health of the crop being grown, further applications may be necessary; the important point is to maintain the advantage gained in this soil war. By now the plant is pretty much in charge of what is going on, unless you compromise your soil army

with applications of 'cides'. If you do need to apply pesticides, then help your soil army recover with a biological activator.

What is amazing is the speed this all happens; for example, if you apply these nitrogen-fixers to the leaf of your plant, within milliseconds these microbes will be translocated to your plant root system. Remember the principle is 'feed your soil and your soil will feed your plant, feed your plant and your plant will feed your soil'.

There is a temptation to apply a carbon source in the shape of molasses to feed the soil but this is not a selective food source and you can cause yourself a lot of problems if you end up feeding the wrong bugs. Better to supply the reinforcements in the shape of megabacters

and feed them.

Nitrogen fixers, phosphate fixers, plant protectants, root growth stimulants, this is your army. Look after it and it will help you to grow high yields of healthy crops; abuse it and there will be consequences to pay.



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PLOWMAN'S FOLLY

By Edward H. Faulkner With a Foreword by S. Graham Brade-Birks M.Sc. (Manc.), D.Sc. (Lond.), of the South-Eastern Agricultural College (University of London), Wye, Kent

First published 1945

Traditions of the Plough

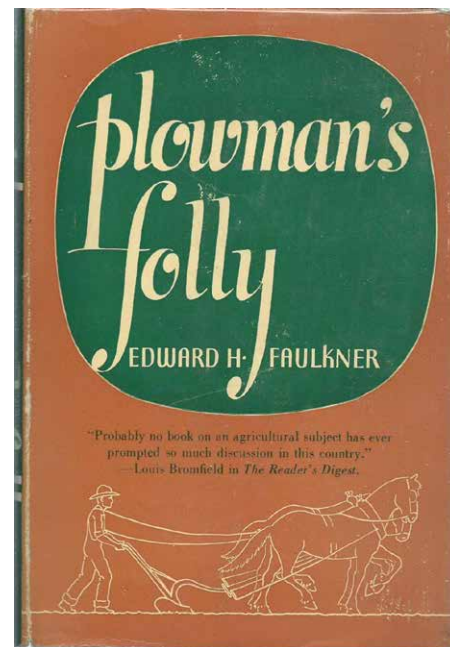
Continued from Issue 1 of Direct Driller

Ploughing done when the furrow slice is plastic creates clods; every clod is so much soil mustered out of service for the season. The tremendous pressure necessary to separate the furrow slice from its base compresses effectively any soil that is moist enough to be plastic; and a moderate amount of clay in plastic soil serves to harden the mass upon drying so that adobe-like clods result. Smoothing implements may reduce the size of these lumps, but as clods they are likely to remain aloof from the rest of the soil throughout most of the growing season.

Such evidence of damage done by the mouldboard has passed unnoticed by farmers as well as by most other

people. Several reasons may be given to account for the public's blindness to obvious faults of the mouldboard plough. To begin with, conditions such as modern farmers face were remote indeed when the plough was first used with a crude mouldboard attachment. The land that had been cleared of trees still was not very well subdued, for it was a hopeless task to try to keep the soil free from competing weeds and shrubs while a crop was growing.

The forest was forever trying to recover the lost ground, and the only really effective tools farmers had against encroaching saplings, perennial weeds, and other unwanted growth were crude hoes, mattocks, and spades. Such ploughs as they had threw the soil both to the right and to the left. They did not cover rubbish very well, much less uproot permanently the wild



Plowman's Folly front cover



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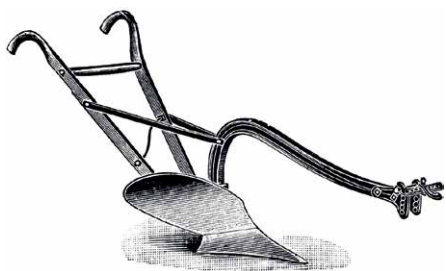
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growth which cumbered the ground. To-day the "bull tongue" plough of the South of the United States of America is of somewhat the same design as most of the ploughs which preceded the mouldboard. Into such an environment the mouldboard was introduced. It was a godsend. Pulled by an ox, or even by men, this plough would actually lift and invert the soil.

This made it possible, by careful work, to eliminate completely the perennial weeds and some of the smaller shrubs. And, what was more important, the farmer who previously could manage only a few square rods now could raise food on an acre or more. Such an invention at a time when England

was never far from actual starvation captured the imagination of rural people everywhere. It was electric in its effects upon contemporary thought. The population now could eat regularly and well, provided enough farmers could have mouldboard ploughs.

Inventions did not occur often in those far-off days. New aids to living were rare indeed. The mouldboard plough, destined to revolutionize the living conditions of world populations, marked the beginning of a new era. So completely did it fill the greatest material need of a poorly nourished mankind that it was accorded a place in people's thoughts such as is usually reserved only for saints and priests. The plough had saved humanity almost literally.

When we come to the eighteenth century we find that in England and America alike, the farmer had more trouble keeping unwanted things from growing than in getting his crops to grow. For him, then, the use of the plough was excellent strategy, because temporarily, at least, conditions were created which made it impossible for the weeds to grow.

This gave the farmer time to get his root and grain crops started before the wild vegetation recovered from the setback caused by the ploughing. Once his crops were well started, the incomparable richness of the soil kept them well ahead of the weeds.

Now that the richness has completely disappeared from most land in the United States, our proper strategy may well be the exact opposite of what was advantageous then. His ploughing, even though it covered a lot of organic matter, could not create for him the sandwich, organic matter profile (OMP), for there was too much depth of blackness in the soil. The crude mouldboards of the eighteenth century could not be favourably compared with the burnished products of today's factories. Hammered out by hand at forges erected at or near the ore mines, they could become smooth only through much use.

They were designed by guess after many trials and did not become stabilized to dependable shape until a century after farmers began to use them generally. Despite its shortcomings - much easier to appraise

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from our perspective than from that of the contemporary farmer -- the plough was, even in its crude state, the greatest invention of the age. It dispelled hunger as the first oil lamp dispelled darkness. Aladdin's lamp could not have been more wonderful.

When in the middle of the nineteenth century the first experiment station was established at Rothamsted, England, no one seems to have raised a question whether the neat work done by the mouldboard plough might be responsible for the trouble farmers were beginning to have growing crops. The men of science who manned that first station, as well as those in charge of the state experiment stations later established in the United States, inherited an unquestioning reverence for the plough.

The doctrine of the Divine Right of Ploughs passed down from generation to generation, so that the possibility that the plough might account for the waning fertility of the soil never seriously occurred to anybody along the line. For decades, to my own personal knowledge, men have sensed that the ploughing in of a layer of organic matter at the ploughsole must of necessity interfere with capillary movement; but the subconscious feeling that The Plough Can Do No Wrong apparently prevented anybody from doing anything about it. The result is that, although we have had experiment stations in America for more than three-quarters of a century, no one of them conducted tests, before 1937, designed to compare directly the effects of ploughing, on the one hand, with the surface incorporation of all organic matter on the other.

Failure to do this has definitely handicapped the development of basic soil information which might easily have prevented the debacle toward which American soils have been drifting. The failure to harmonize the implications of ordinary observations with really scientific information may be the result of historical lag, or an attitude of mind, or mere carelessness, or, finally, a combination of all three. If we consider the published recognition given to the importance of organic material in the soil surface, especially since the opening of the present century, it is difficult to avoid assessing

blame, on the score of carelessness, against those who did not look beyond their immediate data to the established data gained from ploughing.

This is almost implicit in the following: The Yearbook of the United States Department of Agriculture for 1903 carries this statement on page 284:

"Decayed organic matter, by itself or in combination with mineral soil, absorbs moisture much more rapidly than soil containing little or no organic matter; hence, the greater the amount of leaf mould and other litter, the more rapidly will the rain be absorbed. Rapidity of absorption is also influenced by the degree of looseness of the mineral soil. In the forest the mulch of leaves and litter keeps the mineral soil loose and in the best condition for rapid absorption."

If such a statement seems sufficiently old for its validity to be questioned, compare it with the following, taken from pages 609-10 of the Yearbook of the same department for the year 1938: "Forest litter -- the carpet of dead leaves, twigs, limbs, and logs on the forest floor -- serves in several ways. Water falling as rain on bare soil dislodges silt and clay particles by its impact. These are taken into suspension and carried into the tiny pores and channels between the soil particles as the water makes its way downward.

Very shortly the filtering action of the soil causes the openings to be clogged by the particles; water can no longer move downward through the soil, so it flows over the surface carrying with it the dislodged silt and clay; and erosion is actively under way. A protective layer of litter prevents this chain of events by absorbing the impact of the falling drops of water. After the litter becomes soaked, excess water trickles gently into the soil surface, no soil particles are dislodged, the water remains clear, pores and channels remain open, and surface flow is eliminated except in periods of protracted heavy rains." I can detect no significant difference in the meaning of the two quotations. The latter gives a more intimate picture of the processes involved, but it fully confirms the less graphic description in the earlier statement. Moreover, every intelligently conducted experiment

so far undertaken in this direction confirms the truth presented.

A paragraph from a letter dated February, 1940, should be interesting in this connection: "The Department of Agriculture has long been interested in developing new methods of soil treatment which will maintain and build up the organic matter content of the soil. Studies carried out by the Soil Conservation Service at a number of locations have already produced unusually outstanding results along this line. At Statesville, North Carolina, for example, it has been found that several inches of pine needles spread over the soil surface reduced the loss of soil by erosion to a point almost beyond measurement. There was also a considerable increase in the organic matter content of the soil and indications point to a worthwhile increase in crop yields.

In Nebraska subsurface tillage, which leaves straw and other litter undisturbed on the soil surface, has proved remarkably effective in reducing soil and water losses and in preliminary experiments has led to a material increase in the yield of several crops tested." This was signed by the Assistant to the Secretary of the United States Department of Agriculture. It may be said that my letter, to which this was the reply, had mentioned and asked for comment on the fact that the mouldboard plough had never been put to test for validation. No mention of the matter was made in the official reply.

The fact that no advance whatever is apparent, when the statement of 1903 is compared with those of 1938 and 1940, indicates that effort to implement the earlier findings into general farm practice has been neglected. The statements from the yearbooks refer to forest soils, of course; but that fact must not obscure the larger fact that the findings discussed concern principles of universal application. Principles which are valid in the forest are valid in the field, always; so it seems that researches into the importance of organic matter on the surface of crop land should have been started as soon as the earlier announcement had been made. If any such work was begun earlier than 1937, I have been unable to find any record of it.

DRILL MANUFACTURERS IN FOCUS...



Simtech T-Sem

A LIVING SOIL - THE KEY TO A SUSTAINABLE FUTUREMANAGEMENT

Simtech Aitchison has become a major player on the UK direct-drilling scene in recent years, producing a variety of machines all based on the Inverted T-Slot principle. They cover the broadest range of direct-drills on the market, encompassing arable, mixed, upland and lowland pasture and forage crops, to narrow drills for sowing cover crops in vineyards, walnut groves and orchards.

Simtech's direct sales policy means that they are in constant contact with progressive and innovative farmers and producers, focussed on improving and experimenting with their crop-establishment and production methods. This gives the sales team a rich and varied insight into how sustainable agricultural systems are evolving into the future, which they in turn use to help customers get the best out of their purchase.

"No-Till is not an adequate term for what we are looking to achieve" says Simtech's Simon Clarke. "Conservation Agriculture embraces the broader concept much better. Direct-drilling is a vital part of this equation, but needs to be allied with a diverse rotation, good residue management and optimum cover crop usage, to reach its full potential."

"It's important to think of the soil as a living system and not a growing medium. Given the right tools, a living soil is capable of looking after itself and

providing most, if not all, of the nutrients a crop needs. Cultivation disrupts the soil's biology as well as its structure – tillage is detrimental to worm, mycorrhizal fungi and predator beetle activity, to name just three."

"Cover crops do just what they say, along with the crop residue they cover the soil to protect it, feed worms and suppress weeds. A living soil can also hold onto much more water, therefore keeping crops growing for longer in times of drought. But of all the elements to building a healthier soil it is the Mycorrhizal Fungi that is the key. Hidden from view it is the web that drives all soil biology and responsible for making available nutrients that were previously unavailable to plants, producing proteins that are essential building healthy soil and protecting plants against pests and diseases."

Simon Clarke continues, "So the benefits are real and the savings on inputs can be massive. As we are presently moving into uncertain times and the near certain loss of main stream subsidies, adopting a more sustainable approach could mean the difference between profit and loss. Around the world, early adopters of Conservation Agriculture have seen their productivity and profitability soar, so this is a real thing and not a theory. It takes effort and commitment, but nothing is easy."

Simtech continue to develop their machines to work in the environments seen in Conservation Agriculture, from drilling cover crops into often hard dry conditions directly after harvesting, late autumn drilling, when the soil can be quite wet, through to the spring drilling of cash crops into those same cover crops.

With new trailed models planned for 2019 they are looking to offer the larger farmers the same capabilities that their core smaller and medium size customers have enjoyed for many years.



Simtech have also been designing in extra versatility with a range of systems to allow one, two or even three extra products to be accurately applied at the same time as drilling. Drills are available with one or two Stocks Rotor Meters for slug pellets and low dose fertiliser, which can both be metered into the airflow with the seed. A Stocks Turbo Jet can also be specified for slug pellets, fertiliser or seed for companion cropping in Oil Seed Rape. Simon Clarke says, "In 2018 we also developed a new model of our popular 300 and 300A Box Hopper drills. Called the T-Sem 300 Micro it has an additional 150 litre capacity "Micro Hopper", which uses the same sponge feed metering as the main hopper and is capable of introducing slug pellets, seed or micro fertiliser into the seed slot. This makes for a very low cost, but incredibly versatile drill for smaller farmers or someone just starting out with direct drilling."

Liquid fertiliser is also now available across the range, with front mounted tanks up to 1800 litres and a choice of control systems including ISOBUS compatibility.

To sum up Simon says, "Our whole philosophy is versatility combined with simplicity. We feel farmers need a crop establishment system that puts as few constraints on them as possible and many of our customers report that owning a T-Sem opens up new possibilities they had previously not thought possible."



FARMER FOCUS

CLIVE BAILYE



FEATURE

18 years ago, we bought our first self-propelled sprayer and it revolutionized access to land, it was light and well balanced and made fertilizer and crop protection applications easy. Our timeliness and the ruts we used to leave in tramlines all but disappeared.

Back then If you had told me I would ever consider running a trailed sprayer on my farm again I would have thought you were mad. I was once told the difference between a good farmer and a bad one was "a week" so I have always placed ability to travel and make timely application of inputs highly on my list of farming priorities.

So why today do I find myself the proud owner of a new trailed sprayer? Both bigger and heavier than any sprayer we have ever run before, and why am I more confident than ever of timely application with this heavy weight monster? What changed?

Soil is what changed, and nothing is more demonstrative of that than this increased ability to carry traffic. The improved structure that has resulted from zero till can be seen through infiltration tests proving how its structure today can far better cope with rainfall events. Like many other UK farmers most of the land we farm has

a now ageing drainage system under it, these systems were put in when grant money for such infrastructure investment was available. Tighter economics means many such systems are now getting tired and becoming less effective and in need of investment which for many is simply just not available. Drainage is essential to consistently successful zero till but doing so with a digger and pipes is a very long-term investment and certainly not something many tenant farmers would consider on a short-term contract.

Under our previous min-till system ponding was not uncommon and wet spots that could swallow a sprayer lay in wait to catch us out when pushing application windows after significant rainfall. Each year of zero till these areas seemed to get smaller, the temptation to subsoil them was resisted in favor of a light late spring surface cultivation and cover crop mix

established on any such bare patch or sticky headland, nothing repairs structure better than roots and the soil biology that surrounds them and it seems that if you can create a good natural structure it can go some way to making up for the failings of an ageing 1960's drainage scheme. Get enough wildlife working through your soils vertically and they create a massive network of small drainage channels that can quickly help move water from the surface down to storage in subsoils or out to existing drains very quickly. Worms do this very effectively and I have seen studies that show the combined area of the galleries they can create in a long term zero till soil can total the equivalent of a 4" drain every square meter of the land, if you try to visualize what that would look like it's very difficult to imagine water ponding on any surface with a vertical drain every square-metre.

Less is more when it comes to creating structure, if you plough 10" then then a heavy load will easily break through that 10" of structureless soil, if you min-till to 6" that will be the depth of your ruts when making applications in less than ideal condition, however if you don't cultivate at all eventually your natural structure will improve to a point where it can carry much greater loads before failing. Cultivations simply destroy the essential channels and break down aggregated structures created by soil life making it a lot harder for water to flow away from the cultivated zone. This means in high rainfall events the soils soon reach capacity making it impossible to traffic and, in many cases, leads to run off, soil erosion and resulting pollution and sedimentation of our water courses.

Of course, soil doesn't change overnight, it's a gradual process so getting to a point where increased structure and infiltration can carry heavy loads needs thought and planning. I'm not a big fan of strict controlled traffic farming systems (CTF). Along with the often-high capital cost of adoption I have always felt it dictates too much, causing compromises with



important residue management strategies. Although maybe a necessity in farming systems that depend greatly on very heavy high horse power tractors my view is that it's surely better to just not use potentially damaging machines when you have viable lighter, lower ground pressure alternatives usually employed in zerotill systems.

A less prescriptive form of CTF has however played a vital part when it comes to the parts of our farming system where weight is unavoidable or ideal conditions not always possible. In our case this has been controlled traffic of application and harvest equipment. Fixing tramlines and boom / header width in multiples of 12m has helped us keep damage from such operations localized and allowed targeting of any remedial work.

In the early years of system change such remedial work consisted of just leveling any rutted areas and resisting temptation to work deeply which would simply put any longer-term changes to structure right back to square one. Gradually the ruts got shallower and less frequent the heavily trafficked application tramlines became settled and compacted preventing deeper sinking. Our route onto the land had become more stable whilst the soil around it had become better able to infiltrate and cope with weather significantly increasing our windows of application.

Increased workload over the last decade means today we need more application capacity than ever, our self-propelled machine was ageing and replacement long overdue. The tractors we use today are much smaller than they were and with almost no cultivation to do are covering less hours than they ever did making them the perfect match for a modern self-propelled sprayer. The capital cost of a similar spec self-propelled machine was over double that of an equivalent trailed machine. From a financial point of view the savings from the change are significant and fit in well with the ethos behind our farming system of keeping things as simple, minimal and as few engines (which equals potential repair bills!) on the farm as possible.

It's not all positive however, tractors don't have the clearance of a self-propelled machine and changes between row crops and low ground pressure wheel equipment would take longer and be more frequent, trailed machines are not as "handy" in the smaller fields, backing into corners and working around obstacles. These are compromises we considered long and hard



before making the decision to change. To mitigate this, we have moved from 24m to 36m tramlines. 36m still fits with the harvest operation where we control the unavoidably heavy machinery and 12m base organic fertilizer and lime applications yet even when running wide tractor tyres all year around the area lost to uncropped tramlines and reduced ground clearance is not much more in percentage terms than that lost to narrow wheels on a 24m system.

18 years ago when we bought that first self-propelled machine we found a machine that fitted our soil, today I feel like we have made our soils fit the machine and can bank the capital saving that brings.

Farming systems are often compared primarily on agronomic merit. Often the first thing I am asked about our transition to zerotill is how do the crops yield? or what are gross margins like? Others are interested in the operational cost savings we have made like fuel and wearing metal. Although not insignificant none of these things are where the truly fundamental business changing difference are.

Zerotill creates opportunity for complete business restructure, radically different rotations that include higher % of spring cropping may provide lower rotational average gross margins, but they also provide serious scope for cost cutting as well. UK agriculture has been obsessed with gross margin for too long and has lost sight of more fundamentally important profitability. Chasing the maximum output rainbow has led many of us to unsustainable rotations

and the current decline in soil health bringing symptoms like blackgrass, pest, disease or plateauing and even declining yields for some.

As my recent change to a trailed sprayer demonstrates, smaller tractors add flexibility in their use and without cultivations to complete along with their drivers have more time available for more varied "all-rounder" operations. The restructure here has been gradual, we never had a farm sale or made anyone redundant, we let things evolve and made machinery changes as and when they needed making and, in many cases, simply took on more work without needing to invest in additional infrastructure to complete it.

Today our capital employed per acre is less than half the level it was when we min-tilled and a quarter of the level I believe would be required should we return to the plough, depending on circumstance that reduces debt and its cost or provides capital to expand or diversify. The increased diversity and spread of our rotation has reduced average gross margin, spring break crops will never compete with the output of a decent crop of winter OSR but with a lot less bills to pay does that really matter? These fixed costs savings are what makes the difference and will become essential in the potentially un subsidized trading environment we all face in the years ahead

The big question is though as small becomes the new big here just how far will things go? Will I look back on this in years to come while my swarms (if that's the correct collective noun) of robots work the land and laugh at what I once thought was "small"? Will my recent purchase be my last sprayer? There are some exciting times ahead of agriculture, nothing short of an agricultural revolution is on our doorstep and I really can't wait for the many exciting challenges and changes that will bring.

PRODUCT IN FOCUS...



BIOFIL - LIQUID ORGANIC SOIL INOCULANT IS NOW AVAILABLE IN THE UK

BioFil is a liquid organic bacterial soil inoculant which has been used by Hungarian farmers for more than 5 years with great results. The products are finally being launched in the UK and will be available from Farm Marketplace from January 2019.

Research with pH-specific soil microbes commenced in Hungary more than 12 years ago, when scientists of BioFil Ltd. recognised that there was a need to find a way to grow crops in soils with extreme pH, either acidic or alkaline.

They set out to find species of naturally occurring soil microbes that would support plant growth, help to improve soil structure and increase crop yields while at the same time re-duce the application rate of chemical fertilisers.

Today BioFil Ltd. has a dedicated team of 25 researchers, three of whom hold PhDs in microbiology, who are continuously seeking to improve the performance of BioFil products through careful selection of bacteria and to develop new products and services.

The current range of BioFil has six products: BioFil Acidic (pH 4-6), BioFil Normal (pH 5-7), BioFil Alkaline (pH 7-8), BioFil Pea/Bean, BioFil Soya and BioFil Post Harvest.

Each of the products include up to 7 unique bacterial strains specifically developed with your soil pH in mind. BioFil Acidic contains bacterial strains which reproduce well in acid-ic soil pH. While BioFil Normal contains bacteria which prefer soils with neutral pH and have an excellent nitrogen-fixing ability. BioFil Alkaline was developed for alkaline soil and effectively suppresses the reproduction of plant pathogen fungi.

BioFil Pea/Bean contains pea-symbiont bacterial strains which increases the formation of nodules and provides plants with nitrogen. Peas and beans become healthier and more developed, more resistant to various diseases. The bacterial inoculant BioFil Soya is re-sponsible for

soya nodulation. It contains a symbiont nitrogen-fixing bacterial strain.

BioFil Post Harvest is used for intensive degradation of cellulose and can multiply even in low soil temperatures which makes it very effective in degradation of stems, leaves and roots so that the next plant culture gets access to valuable nutrients. There is no need to apply nitrogen for stalk degradation as this product contains nitrogen-fixing bacterial strain of high capacity.

Field trials conducted in Hungary have been continuously providing highly positive re-sults. In 2018 a green pea trial where acidic soil was treated with BioFil produced a sig-nificant yield increase of +26.7%. Also, yield increase of +40% was reported in 2016, and +50% was reached in 2015. While sunflower trials conducted in 2017 showed yield in-crease of +23.1%, potato trials conducted in 2017 produced +6 tonnes per hectare, and in the last few years soya trials (some of them utilised acidic soil inoculant) showed in-crease of between +9% and +42.9% in crop yield.

This year BioFil established their fist trials in the UK with the autumn crops. They used acidic soil inoculant for 5 ha of winter wheat, 3 ha of OSR and 2 ha of beans. Each of the products was used with no-tillage, either a Cross Slot or a John Deere machine. The crop results will be reported after harvest in the Direct Driller magazine.

While BioFil makes no recommendations with regards to lowering of chemical fertiliser application rates, when the products are applied as directed they have the effect of providing the equivalent to approximately 100 kg/ha of chemical NPK. This is achieved through the inclusion of high concentrations of nitrogen fixing bacteria that solubilise phosphorous and potassium in the soil that cannot otherwise be accessed by plants.

BioFil products are well proven to be reliable and very cost effective over a broad spec-trum of crops and as a generalisation, for monocots yield increases are usually in

the range of 5% to 15%, and for dicots 5% to 25% when compared with a control that re-ceives the grower standard chemical fertiliser application.

However, with different seasonal growing conditions yield increases vary and being products containing very high concentrations of living soil micro-organisms, they need to be handled carefully and applied in the correct manner to achieve the expected results.

Because the bacteria can be damaged when exposed to UV radiation, it is essential for the liquid applied to the surface of the soil to be incorporated into the soil to a depth of 5 to 10 cm.

While this is not an issue when applied under no-tillage, under conventional tillage, the BioFil is applied during a tractor pass over the land preparing the seedbed or at the time of seeding, and needs to be raked into the soil.

A tank and spray system known as BioFil Jet has been developed, which can be at-tached e.g. to the front of a tractor and applies the liquid at the rate 50 litres/ha, and in the same pass over the land is incorporated by a rake towed behind the tractor.

The products are competitively priced. It is not uncommon for experienced users in Hun-gary to achieve a yield increase and input cost reduction of up to 10 times the cost of the product.

BioFil products have a shelf life of 6 months when held under refrigeration at 4 °C to 5 °C and up to one month at 20 °C. Orders placed with Farm Marketplace at least one month in advance of the estimated application date will be guaranteed delivery of product that has been held under refrigeration and has a shelf life of 20 days on the farm at 20 °C

The products will be available from www.marketplace.farm.

For more information about the products go to www.terragro.hu.



WHY DOES SOIL HEALTH MATTER?



How much do you really know about your soil and its health? Elizabeth Stockdale, NIAB and knowledge exchange lead for the AHDB Soil Biology and Soil Health Partnership takes a closer look.

Recent work on soil management carried out by AHDB with grower groups across the country highlighted a lack of information on soil biology and soil health. Soil physics, chemistry and biology are interlinked and all play a role in maintaining productive agricultural and horticultural systems. While physical and chemical properties of soil are relatively well understood, the same is not necessarily true for soil biology.

Soils contain a very high diversity of organisms. Until recently only around one per cent of all soil micro-organisms had been identified. Soil organisms interact with one another and the chemical and physical properties of the soil to drive soil processes, such as:

- Release and recycling of nutrients
- Forming and maintaining soil structure to maintain water and aeration
- Both causing and controlling plant diseases and pests
- Nitrogen fixation or increasing nutrient availability through beneficial relationships with plant roots

Together interactions between soil physical, chemical and biological factors contribute to soil health. In the same way we measure our own health by our ability to carry out our normal everyday tasks, healthy soil can be recognised by its outputs/functions i.e. healthy plants, animals and ultimately humans.

It is useful to consider whether we can identify underlying indicators that



help us identify when soil is in a healthy or unhealthy state – the equivalent of taking a soil's blood pressure and temperature. Because of the wide range of soil types, climates and farming systems in the UK, it is important to put such indicators into context.

AHDB's GREATsoils programme pulls these three factors together and provides valuable information on soil management for growers and agronomists. Funded in 2016, the Soil Biology and Soil Health Partnership aims to fill a gap in knowledge and help farmers and growers manage soil health better.

The Soil Biology and Soil Health Partnership, 2017-2021

Funded by AHDB and BBRO, the five-year Soil Biology and Soil Health Partnership is a series of cross-sector research and knowledge exchange projects. Each is designed to help farmers and growers maintain and improve the productivity of UK agricultural and horticultural systems.

The key output of the Partnership will be a toolkit including an integrated scorecard to help growers measure and manage soil health. All the outputs will

be designed with farmers and growers so they can be easily understood.

The Partnership comprises eight scientific partners and six industry partners and this breadth of expertise provides a robust practical and scientific foundation. However, we recognise that farmers and growers have already taken the initiative to understand the health of their own soils and a great deal of work is already being done on-farm to experiment with ways to optimise soil biology and health.

“Until recently only around one per cent of all soil micro-organisms had been identified”

Therefore, from its outset the Partnership has sought to work closely with farmers, growers and advisers to draw together and build on current knowledge and experience. Crucially, the Partnership will also involve key players in the agri-food sectors to direct the work and maximise the practical relevance of its findings in modern farming rotations.

Findings so far

In the first year of the programme, we have:

- Updated scientific reviews of soil biology and soil health
- Developed a model that provides an easily understood summary of the effects of soil management on soil biology and soil health
- Identified a set of methods to measure soil health on-farm which can be used to support practical decision-making
- Reviewed molecular-based approaches that can be applied to assess soil biological function

In recent years, a range of indicators for soil biology have been developed. It is now possible to measure soil



Elizabeth Stockdale

chemical, physical and biological properties. Some of the best measures of soil physical structure and its stability can be completed in the field whereas most chemical properties need samples to be sent away for analysis. The recommended biological indicators may be assessed in the field (earthworms) or sent away for analysis (soil respiration).

However, often these indicators have not been produced in parallel with the necessary guidance and tools to allow them to be easily used on farm. We have selected some indicators for testing where we will focus on whether the target values/thresholds for soils/farming systems are correct e.g. soil organic matter levels. We are also trying out new DNA-based indicators of the soil biological community in practice.

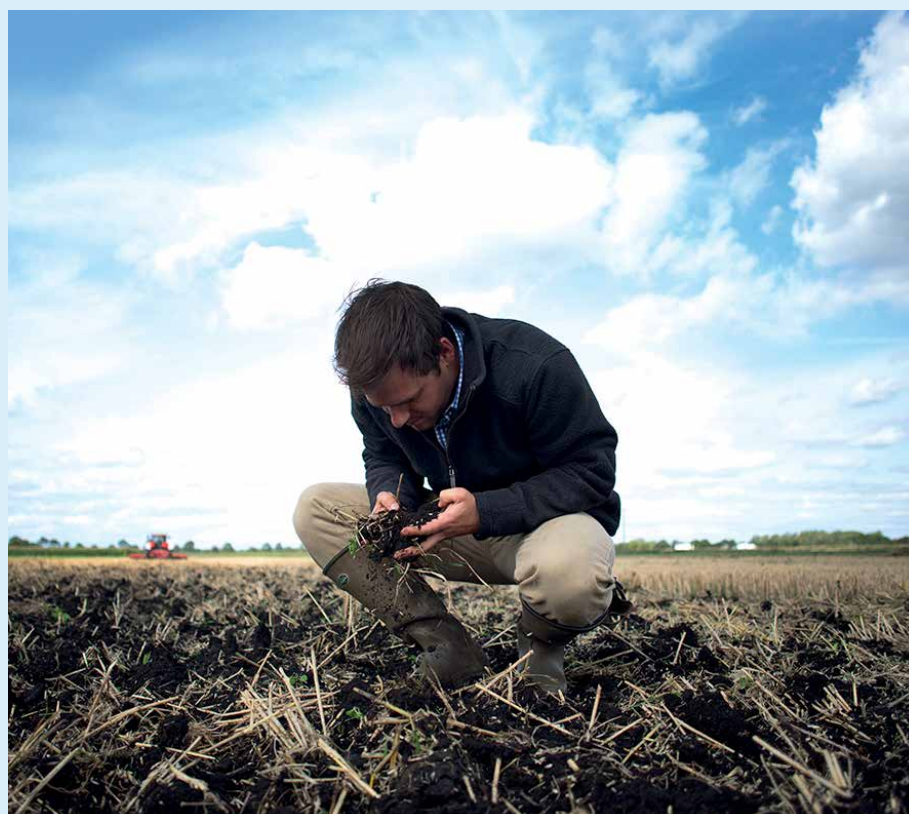
What next?

Over the next three years, we are working on pre-existing long-term soil management trials and on commercial farms to evaluate the performance of the model and to evaluate a new soil health scorecard. This work includes trials on raspberry, onion and narcissus.

Seven long-term soil management trials have been identified which have treatments in place that target the main influences on biological function:

- **Food source** – nutrient and organic matter inputs, cropping choice and sequence
- **Air and water supply** – tillage systems and drainage
- **Chemical environment** – pH

Across these trials and commercial farms, a programme providing detailed



monitoring of crop (yield, disease and weed constraints) and rotational soil health is now in place. Soil sampling takes place in the autumn post-harvest and after the soil has wetted up. A key part of sampling for rotational soil health is the linking of measures of soil physical, chemical and biological properties.

As soils need to be moist, sampling may take place post-cultivation/drilling of winter crops, but leaving a gap of at least one month after soil disturbance. Soil physical properties and numbers of earthworms are recorded in the field at the time of sampling and we are also

collecting cores for the measurement of bulk density.

A bulk soil sample is collected to allow extended soil chemical and biological analysis using the NRM Soil Health package plus direct measures of soil organic carbon, total nitrogen, potentially mineralisable nitrogen, microfauna and nematodes. The same soil samples will also be used in the development and validation of DNA-based soil biological indicators.

To allow control of the factors under study, many research trials have specific and narrowly focused remits, often with limited acknowledgement of rotational impacts. Consequently, implementation and impact of soil management on farms has been less well studied.

The Soil Biology and Soil Health Partnership is deliberately taking another approach and is working with farmer and grower research-innovation groups to evaluate the impacts on soil biology and health across a broad spectrum of crops including field vegetables, climates, soil types and rotations.

For more information on soil biology and soil health visit:
www.ahdb.org.uk/greatsoils

GREATSOILS



APHIDS, BYDV MANAGEMENT AND **NEW RESEARCH**

Virus-spreading aphids and the risk they pose to winter cereal crops are the subjects of a new management tool and a research project funded by AHDB.

Barley/cereal yellow dwarf viruses (BYDV) are mainly transmitted by the bird cherry-oat aphid and the grain aphid – via wingless and winged forms.

Wingless aphids, which live on grass or volunteer cereals, can colonise the following cereal crop. This 'green bridge' can be managed, to various degrees, through cultivations.

Winged aphids migrate to newly emerged crops from grass, volunteer cereals or elsewhere. In most years, this infection route stops in November but it can continue throughout mild winters.

Initially, aphids colonise relatively few crop plants. When the second generation offspring are produced, these tend to move away from the plant originally colonised. Consequently, controlling this generation is a key component of a BYDV management strategy.

The timing of the second generation can be approximated by accumulating daily average air temperatures above a baseline temperature of 3°C. It takes around 170 'day degrees' (DD) for the second generation to be produced.

To use a simple scenario, daily average temperatures of 20°C for ten consecutive days – $(20^{\circ}\text{C} - 3^{\circ}\text{C}) \times 10$ days – equates to 170DD.

As average daily temperatures decrease throughout autumn into winter, earlier drilled crops usually

reach the 170DD threshold quicker.

DD calculations should start either:

- On the day of emergence for untreated crops
- When aphids are present and protection from neonicotinoid-treated* seed has run out (around eight weeks after sowing). *Only available for cereals drilled before 19 December 2018
- Following a pyrethroid application (account for product persistence, see label)

Powered by the AHDB WeatherHub, the BYDV management tool features a UK map of weather stations. People can select their nearest weather station (or stations, by selecting a 'Region') and select a start date (using the slider) for DD calculations.

Once 170DD has been accumulated, the relevant line on the chart displayed enters the yellow zone. At this stage, crops are estimated to be at risk and treatment should be considered.

BYDV risk is highest during the early growth stages and passes at GS31. Prolonged cold periods can also reduce the risk significantly.

The BYDV management tool should be used as part of efforts to minimise insecticide use and to manage resistance threats. Grain aphids with moderate levels of resistance to pyrethroids are already widespread in the UK, although effective control should still be achieved at full label

rates. At present, there is no evidence of insecticide resistance in bird cherry-oat aphid.

The BYDV Tool

AHDB have released a BYDV management tool (available at: cereals.ahdb.org.uk/bydv) that can be used to predict when the critical second generation aphid offspring (and subsequent generations) are likely to spread through cereal crops.

The tool uses air temperatures, from a network of weather stations, to predict when critical second generation aphid offspring is likely to spread through cereal crops.

Farmers and agronomists are being asked to use the tool to both target sprays this season and consider how management might need to change in 2019 – when early aphid protection from a neonicotinoid seed treatment will no longer be an option.

New research on BYDV risk

A new research project has also been funded by AHDB to look in



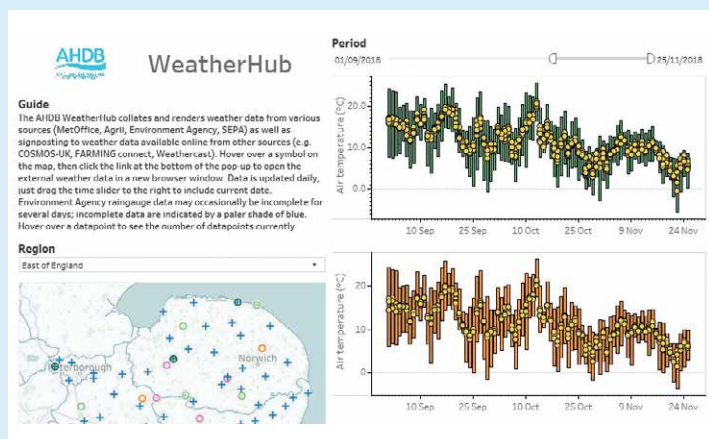
Field infected by BYDV



Grain aphid on ear



Bird Cherry oat aphid



more detail at future management of BYDV.

The research, which explores in-field aphid monitoring techniques and control approaches, will deliver results by next autumn – when cereals will be drilled without the protection afforded by a neonicotinoid seed treatment.

The Game and Wildlife Conservation Trust (GWCT) has been awarded the contract to lead the work.

Commercial and research trials will be used to test in-field monitoring approaches. The trials include the use of sticky traps designed to catch winged cereal aphids. The researchers will explore trap designs and placement. Critically, the team will establish any relationship between the number of aphids trapped and the number flying.

Observations of BYDV levels in trials will be used to identify or confirm risk factors. Many factors will be investigated, including those relating to landscape characteristics, cultivation approaches and the presence of natural enemies.

Farmers and agronomists will be actively involved in the work, including the provision of trial sites and opinion, to ensure project outcomes are relevant to industry.

Charlotte Rowley, AHDB Crop Protection Scientist, said: "Full-rate pyrethroid sprays can provide effective control of aphids but they are becoming resistant. At present, this is limited to moderate levels of resistance in grain aphids. Knowledge about BYDV risk needs to be improved, to make sure sprays are only ever used as a last resort."

For more information on aphids and BYDV visit: cereals.ahdb.org.uk/aphids



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ASSESSING MACHINERY POLICY BRINGS DIVIDENDS

The AHDB Monitor Farm network have run a Labour & Machinery review on over 20 farms stretching the length and breadth of the UK, here AHDB's Harry Henderson shines a light on the findings

Across the AHDB Monitor Farm network, with the help of Strutt & Parker we have run a Labour & Machinery review on over 20 farms stretching from Morayshire in the north of Scotland to Truro some 700 miles to the south.

At each Monitor Farm meeting on these farms, we have discussed the Monitor Farmers costs, and given the attendees a way of quickly calculating their own costs, so they can easily see if costs are in the ballpark or heading upwards, with no change in farm output to support the uplift.

It could be easy to assume that there are a set of numbers each farm must get close to, to achieve good business results. We have all heard statements like getting below 1.5HP/ha, farming more than 300 hectares, employing 1 person per 1000 hectares are benchmarks every farm should work towards. The reality of course, it is not that simple. Each farm business has different objectives and attitude to risk, lifestyle and yes, vanity comes into it too.

There is nothing wrong running the business however you like, so long as the machinery policy is sustainable, affordable and able to weather the unknown years ahead. So



understanding your costs is vital and reducing soil movement costs could be seen as low hanging fruit.

Looking at crop establishment costs in particular, from a full Lemken plough and 6 meter mounted powerharrow drill combination through to a one-pass Sumo DD, and most machines in between, where costed out in the same format the costs of drilling one hectare of land ranged from £16 to £63. Of course, in most situations, it's the work carried out ahead of the drilling operation that matters, how many times have you seen a min-till drill working in a seedbed a Massey 30 drill could cope with?

So was it a Massey 30 costing just £16/ha to use, and what is costing £63?

Tractor	Drill	Area covered	£/hectare
John Deere 6930	Weaving 6m tine	322 ha	£16
Case Puma 225 CVX	Vaderstad Rapid 4m	419 ha	£17
John Deere 8370RT	Horsch Sprinter 8m	1,030 ha	£20
Claas Axion 850	Vaderstad Rapid 6m	637 ha	£26
Case Quadtrac 485	Vaderstad RD800	1,850 ha	£26
John Deere 7530	Claydon 4.8m	382 ha	£27
Case Puma 180	Kuhn Combination 4.8m	382 ha	£28
Fendt 939	Lemken 6m Combi	769 ha	£28
Massey Ferguson 8737	Sumo DTS 6m	1082 ha	£29
Fendt 716	Vaderstad Rapid 6m	222 ha	£30
Fendt 826	Sumo DD 5m or Sumo DTS 5m	465 ha	£42
Contractor	Powerharrow-drill combination	218 ha	£63

It goes without saying, there is a whole other story behind each of these drill set-ups in terms of pre-cultivations and little can drawn upon these figures alone. Having said that, the farm that runs a strip-till drill and/or a no-till drill could be seen as able to draw on technology for any soil condition and still comes in costing below a contracting charge for a powerharrow combination. That makes you think.

If you were wondering, the Massey Ferguson 30 4meter drill, pulled by a



David Brown 1494 Hydrashift covering 55 hectares last year cost just £7/ha to operate, using family labour. The stand out point here is that depreciation is nil. The issue might come when you give this rig 200 hectares to do, running the risk of break downs and missed drilling windows, adding costs in another way.

At the AHDB Monitor Farm meetings, we have been using a simple paper based calculator to give a quick calculation of machine costs. It's better than a back-of-an-envelope calculation



but if you need to consider downtime (rainy days) of farm staff, more accurate fuel calculations and depreciation based on machine replacement value then that falls outside the scope of this calculator. But as a quick guide, it's good enough.

Search 'AHDB machinery cost calculator' on-line and it will pop up. Or visit: cereals.ahdb.org.uk/tools/machinery-cost-calculator



What are the top tips from this review?

Drawing comparisons across all the Monitor Farms you soon see just how different businesses really are, but here are six top machinery policy tips from the top 25% of performers;

1. Low depreciation costs per hectare. Depreciation is the largest cost in running a machine at 33%, followed by fuel at 26%. There is a positive correlation between depreciation costs and the overall operation costs; all of the top 25% achieved low operational costs with machine depreciation costs below the average of £63 /ha. This was achieved either through simply operating over a large area (those with a low HP/cropped ha). Where this was not possible, low depreciation costs were also achieved either where the machines were kept for longer (beyond 7 years) or residual values kept high through regular maintenance.
2. Low repair costs per hectare. Low repair costs were not exclusive to farms running newer equipment. Farms with older machinery still achieved low repair costs through tactical hiring of key equipment (eg. the combine), or through employing experienced staff who could carry out basic maintenance and repair work on the machines. The adoption of a prolonged replacement policy should be evaluated on a machine-by-machine basis, identifying those which can be easily repaired/serviced and for which reliability is not paramount.
3. Low diesel usage per hectare. As fuel is the second largest cost of running a machine (26%), the top 25% were all using less than 100 litres of gas oil per cropped hectare on average.
4. Low machine costs per hour. The top 25% had hourly machine costs for their main operational tractors (e.g. drilling tractor) ranging from £17 /hr to £24 /hr (for 190-250 HP tractors). The low hourly cost of running a tractor created savings in the key operational costs such as drilling. Whilst low machine costs per hour are linked to depreciation, they were also achieved by farms carrying out contract work, or farms with non-arable enterprises which utilise the annual ownership of the machine.
5. Low cost of combining per hectare. Combining is the most expensive operation applied to a crop at £66/ha on average. The top 25% were generally covering more hectares per metre of combine header than the rest at 70ha on average. A 10m header was therefore cutting at least 700 ha. The cheapest cost of combining (£41/ha) was achieved by a 7.3m combine cutting 569 ha (78 ha per m of cutter bar). This machine was also contract hired, and hence had no repair costs associated with it. The average area cut by an individual combine was 545 ha. Interestingly, the most utilised combine (121 ha per m of cutter bar) still had an above average cost per hectare. This particular machine was hampered by small fields, averaging just 10 hectares each. Some Monitor Farms had a combining cost greater than £87/ha, the same as the average NAAC contractors charge rate. Marginal savings from using a contractor may however be outweighed by logistical and timing inconvenience.
6. Size. Whilst there was no clear correlation between size and costs, the top 25% ranged in size from 500 ha to 1,000 ha in cropped area. Economies of scale prevented some of the smaller farms (under 350 ha) from obtaining the lowest cost wheat production. Conversely, some of the largest farms had the highest costs.

It is also important to understand that low tractor costs per hour may not be the best target. A John Deere 8530 in Yorkshire pulls a 4m strip-till drill and nothing else. Totalling just 200 to 250 hours a year it would be easy to assume

the tractor is underutilised and should be sold with a hire tractor brought in each year. But the total yearly costs of the 8530 are half that of a suitable tractor hired in at peak season. A comfortable, reliable tractor with RTK,

the Deere will remain on farm for the foreseeable future.

To learn more or join a Monitor Farm meeting, visit: cereals.ahdb.org.uk/monitorfarms

DRILL MANUFACTURERS IN FOCUS...



BUSY BACKEND AND DISCUSSIONS WITH THE NEIGH SAYERS!

Having travelled all over the country with the Ma/Ag drill we are now beginning to see the results of our toils which seem positive. As always during demonstration, we have visits from the next door neighbour, some with positives comments and some not quite so. On one demonstration which I and the farmer where more than happy with, the visiting cousin was negative to say the least. After his departure, I spoke to the farmer about his cousin's opinion, and had the response that he was very positive until I stepped out of the cab!



Here is a riverbank field, an attempt was made to plough but soon given up, we direct drilled the spring barley into reasonable conditions, all was well until we ventured into the ploughing which appear reasonably dry, it wasn't!

Lesson learned, a 2 ton crop of spring barley (drilled 20.4.18), apart from the ploughed ground, which just grew weeds!



Wheat into rape stubble in Northumberland

I have grown a little tired of the comments that direct drills are only a dry weather tool, we have proved that providing you can travel without making a mess on the surface, and providing your equipment is suitably tired and correctly operated so as not to do damage underneath the surface then pretty much anything is possible. In fact where cover crops have been grown or last year's crop aftermath is still around, these can allow operations where bare cultivated ground might not.



Direct drilling 14 tons/Ploughing 0
I rest my case!
Mark Harrison, Ryetec Ltd



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HOW **NZ CONTRACTORS** NO-TILL 3000HA/YEAR WITH A **3M SEEDER**

By Thierry Stokkermans

There is one country where some contractors seed 3000 hectares per year with a 3 metre wide drill, and it is New Zealand. It is not a country of wide plains... most paddocks have odd shapes. How do they do this?

New Zealand has a mild oceanic climate and numerous mountains. Their climate allows the grass to grow all year long. They stock sheep and cattle, for the meat and the milk. There is some cash cropping but arable farms are uncommon, most farms are all grass or mixed. In this pedo-climatic environment and with this farming industry, it is possible to establish new crops 10 months a year. The limitation is a winter break of about 2 months.

The NZ seeding calendar is the following:

- Towards the end of winter, farmers will seed spring barley, spring peas and some pastoral mixes such as plantain-clover.
- During the spring, they seed grassing crops to get through the following winter such fodder beet, kale and turnip. This is followed by corn seeding.
- Through the spring, temperatures

are getting warmer and seeding get higher and enters mountainous areas.

- Early summer, the high pastures (up to 1000 metres) are reseeded with pluriannual plants such as clover and ryegrass.
- During summer, the seeders will follow the combine harvesters to seed fodder crops in the stubbles and produce a maximal amount of feed for the winter.
- Towards the end of the summer, Oil Seed Rape (OSR) might be seeded but it is a marginal crop in this country and many farmers will reseed older pastures to gain productivity and maximise fodder production the following years.
- Finally, during the autumn, cereals crop will be established and the last fodder crops will be seeded in newly available land such as corn stubbles for example.

Due to its mild climate, its crop diversity

and the landscape, crop establishment jobs are spread over the year and a large number of contractors offers custom-seeding to their customers. Some contractors seed a few hundred hectares with a single machine, other seeds more than a thousand hectares and several seed 3000 hectares with a single 3 meters wide rigid drill.

A 3m machine travelling at 12-13km/h can easily cover 3 hectares per hour. But when the field has an odd shape or the slope is so steep that it is only possible to seed it downhill, the productivity drops quickly. And after adding the road time, the maintenance and talking time with the customer, the tractor will operate about 1500 hours a year in front of the seeder, keeping one man busy all year round.

Many contractors seeding more than 2000ha per machine per year focus on two elements: agronomic support and quality of seeding. The

contractor frequently visits their fields when plants are emerging - it is an agronomic and customer relationship task they commit to. This has several positive points: observing successes and problems; sharpening agronomical knowledge; improving the quality of their work; and getting to know the customer and gain their confidence. After a while, the farmer sees its contractor as an expert and a consultant in seeding and, in this livestock farming country, they can give them the role of decision maker for crop establishment.

Those contractors work under no-tillage regime and operate Cross Slot seeders. In New Zealand, some farmers plow, other do alternative tillage (e.g. min-till) and a number goes no-till. Looking at the machinery, the market offers the same seeders as in Europe such as John Deere, Great Plains or Aitchison (the last one is a kiwi manufacturer). Some contractors propose a complete tillage process, some offer no-till with a John Deere or an Aitchison. But the only one who managed to use their seeder 1000 hours per year and more are short frame Cross Slot seeder owners. The main reason is the Cross Slot capacity to pass all year round in all terrains and, therefore, to allow a high fodder and dry matter productivity. The pro of a short frame on a Cross Slot is that the two seeding beams are close together which make it easier to seed travelling sideways on a slope. Indeed, when seeding across a slope, the tractor-machine combination tends to walk sideways (a bit like a crab), therefore a shorter machine often keeps working for longer and keeps providing good performances.

As a comparison, a contractor from the Waikato region owning a 6 meters wide John Deere 750A only uses its seeder on smooth fields in the autumn. The shorter vertical travel of the opener does not allow him to seed in older pastures which have bumps and holes. And the quality of the seed environment only allows for autumn seeding. Indeed, in New Zealand like in France, the autumn crop establishments are the easiest to succeed in no-tillage.

In New Zealand like in Europe, the Cross Slot opener is heavy to pull.

Furthermore, to pull the machine on a mountain slope, it is important to upsize the tractor and the power. Kiwis mostly use 6 inches row spacing (or 150 mm). A 3 meters wide seeder has 20 openers. On a sandy plain, this will take a 120hp. Working heavy clay on the level it will take up to 200 hp. But New Zealand is a mountainous country and the tractor for such seeder is about 280hp. To provide good traction, the tractor has a decent set of tyres and is ballasted up to 45-50 kg/hp. This adds up to a tractor weighing 14 tonnes - a weight that could give goose bumps but less scary than some of the fields where seeding is only possible travelling downhill.


The invoicing of a Cross Slot seeding operation is about 200 New Zealand dollars (\$NZ) per hectare. It varies from 180 up to 220 \$NZ depending on the area and the contractor. And for the jobs with extremely low productivity, such as tiny field and downhill only seeding, some contractors invoice the worked time (hours) instead of the area (hectare). Seeding operations with an Aitchison or a John Deere are half price. It shows that the difference in cost for the client is justified by the versatility, the seeding quality, the productivity gain and the agronomic support.

Looking at the financial investment, a brand-new tractor + seeder combination with 3m working width cost about 600 000 \$NZ. The seeder costs as much as the tractor (or the opposite). To quickly find the efficiency of an investment, kiwi contractors apply the rule of the third: to be profitable, the yearly invoicing has to be at least a third of the investment. For the above investment, contractors will have to invoice at least 200 000 \$NZ/year which is about 1000ha/year.

For those contractors, the clients have different profiles and have different strategies. Some are engaged in Conservation Agriculture and want to improve their soil. Other wants to maximise short term profitability and get the pastures grazed until the roots (see picture). As any service business: taking the job means bring satisfaction to the customer. Those contractors understand this to the full extent and they are working for and with their customers. To maximise the return on their tractor-seeder combination investment, they are available and mobile. Working on Sundays is common practice. Most of their customers are within half an hour driving from the contractor shed but, sometimes, 2 hours of driving are required to visit a remote customer.

For reference: the current exchange rate is 1.93 NZ\$ to 1 GBPE.

You can read Thierry's blog online at: <https://thierrystokkermans.wordpress.com/>



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COMPARISON OF “STANDARD ROW” TO “WIDE ROW” IN ORGANIC SPRING WHEAT AND SOYBEANS

By Einböck, from their Organic Farming Guidebook

In spring of 2017, organic spring wheat and soybeans were sown in plots (4000 m² each). Each crop was seeded once in standard row (row spacing 13 cm / 5”) and on wide row (row spacing 37.5 cm / 15”).

Location

The test area is located at 4751 Dorf an der Pram (Austria), at an altitude of 460m above sea level. The average annual temperature is 11 degrees Celsius and the average annual rainfall is 900 litres/m² (distributed over 80 days of rain). The soil type is silty loam.

Seeding



A classic seed drill (row spacing 13 cm / 5”), the picture on the right shows a row crop drill (row spacing 37.5 cm / 15”).

At spring wheat, the sowing rate was reduced by 28 % compared to standard row. (345 grains/m² instead of 480 grains/m²) In the case of soybean, 70 grains/m² were sown on both plots.

Basis for calculation:

- Machine costs without driver (OEKL-values 2017)
- Costs for soil preparation, seedbed preparation, sowing and harvesting were not included, because they were identical in both systems

Mechanical weed control:

(Regarding the weather conditions, the optimal times for weed control of the respective crops wasn't possible)

- Spring wheat standard row



- Tine weeding: start of tillering
- Tine weeding: middle of tillering
- Spring wheat “wide row”
- Hoeing: start of tillering
- Hoeing: middle till end of tillering
- Tine weeding: end of tillering

Soybean standard row:

- Blind-weeding: 4 days after seeding
- Tine weeding: 2nd seed leaf was

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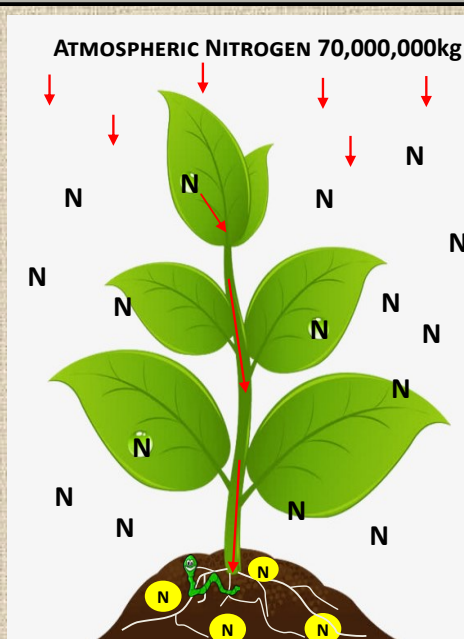
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visible

- Tine weeding: the plant was 10 cm / 4" high

Soybean "wide row":



- Blind-weeding: 4 days after seeding
- Hoeing: 2nd seed leaf was visible
- Tine weeding: the plant was 10 cm / 4" high
- Hoeing: shortly before blooming

Result spring wheat:

In addition to the 5.7 % increase in yield, a 0.58 % increase at the protein content was observed. The increased protein content leading to a higher profit.

* Revenue: for standard row (protein > 13 % protein 415.38 €, according to Agrar Markt Austria for 2016/17 without tax)

* Revenue: for Wide Row (protein > 14 % protein: 442.40 €, according to Agrar Markt Austria for 2016/17 without tax)

Despite the increased cost for weed control, a 10.2 % surplus of profit was possible, because of the reduced seed costs and the higher price for the higher protein content

Spring wheat	Standard row	Wide row (spacing 37,5 cm / 15")
Yield (per plot)	700 kg	740 kg
Protein	13,90 %	14,48 %

Calculation	Standard row	Wide row (37,5 cm / 15")	
Seed costs / plot	€ 70,24	€ 50,57	
Costs for weed control / plot	€ 37,00	€ 74,50	
Revenue / plot *	€ 290,77	€ 327,38	
Profit / plot:	€ 183,53	€ 202,31	
Profit / ha	€ 458,82	€ 505,77	10,23 % surplus profit



Caption: In the left picture you can see the plot seeded on standard rows, in the right picture you can see the plot seeded on "wide rows".

of the spring wheat in the "wide row".

Result soybeans:

Soybeans	Standard row	Wide row (spacing 37,5 cm / 15")	
Yield (per plot)	1.230 kg (24 % moisture)	1.580 kg (17 % moisture)	
Yield at 13 % moisture	1.075 kg	1.505 kg	
Yield / ha	2.687,5 kg	3.762,5 kg	40,00 % higher yield

Calculation	Standard row	Wide row (spacing 37,5 cm / 15")	
Seed costs / plot	€ 323,35	€ 323,35	
Costs for weed control / plot	€ 55,50	€ 93,00	
Revenue / plot *	€ 754,57	€ 1.056,40	



In the left picture you can see the plot seeded on standard rows, in the right picture you can see the plot seeded on "wide rows".

why the soybeans achieve a 40 % higher yield in the wide row than in standard row.

* Revenue: Price for organic soybeans for food industry 2016/17 according to Agrar Markt Austria 701.93 €/t without tax

Despite the increased cost for weed control, a significant increase in profit of 70.4 % was achieved

A GUIDE TO ON FARM TRIALS FROM ADAS

GPS and other modern technologies, along with thorough trial protocols, can make farm trialling straightforward and routine. Decisions and innovations can then become thoroughly validated and tailored to real farming conditions.



This useful guide from ADAS outlines processes leading to successful farm-trialling and how to avoid the pitfalls. The guide covers trials conducted with ADAS Agronomics support, trials using yield mapping technology without ADAS support, and trials where the yields are assessed by weighbridge.

Terms and Conditions that are worth knowing

Bout: Land area covered by one unidirectional pass of a machine, usually from one end of the field to the other: e.g. drill bout, spray bout, spreader bout, or harvester bout.

Tramline wheeling: gap / track in the crop where the tractor wheels pass every time the sprayer or spreader is used.

Tramline width: The width of the spray bout. The most common unit for treatments and plots will often be one or more tramlines wide. The tramline boundary is equidistant between wheelings.

Swath: The crop area harvested in one combine harvester bout, specifically the width cut, sometimes less than the cutter-bar width, because of overlap between harvester bouts.

Plot: area of land where one treatment is applied

Treatment: A decision option, for comparison with one or more others e.g. a variety, a fertiliser rate, or an agrochemical product

Replicate: A repeated treatment (or set of treatments) within the same field.

Standard or control: The treatment that represents normal farm practice

Firstly – What Question are you asking?

- What decision do you want to test? E.g. rotations, cultivations, varieties, fertiliser rates, new products, application timings? Does the importance of this decision merit the effort invested in a trial?
- Most questions have been asked and many answered already. Check with an expert (or search the internet) to see what research has already been done.
- Share your plans: several farms doing the same trial and getting the same results will make the conclusions much more trustworthy and valuable.
- Define the control or 'standard' practice with which you want your new idea to be compared.
- For any question posed, you need an answer that you can use in future. So ensure that the results will be relevant to your farm and unaffected by expected future changes on farm.
- Average farm trials can 'prove' grain yield differences of 0.3-0.5 t/ha. Only the very best farm trials can 'prove' differences as small as 0.1 t/ha. Think about what difference you expect and what imprecision you can tolerate.

Secondly – Is your Farm set up for a Trial

Fields

- Do you have fields with the right crop which are big enough, square enough and even enough?

Equipment

- How easily can you apply the different treatments that you want to test?

- How will yields be measured: using yield mapping or a weighbridge? This will affect trial design and management.
- If using yield mapping, do you know how to retrieve and process the data?
- Can you geo-locate tramlines, treatments and yields accurately? Mobile phone precision is crude (>5m). RTK gives the best GPS accuracy (<1m).
- Can you acquire other useful measures? E.g. soil maps, crop sensing, satellite imagery, or drone photos.

Attitude

- Will you be willing to put up with extra hassle at harvest?!
- If using a contractor, are they fully on board?

Designing the Trial & Choosing the Field

Split fields versus Replicated Trials

- With split fields it is difficult to tell if any effect is real, or simply due to underlying variation. At the least, test any new treatment in a block with standard on either side, then gauge the variability between standard areas to judge your confidence in the treatment effect.
- Applying treatments in replicated plots takes more effort, but allows greater confidence in the results.

Designing your trial

- There is no single 'best design'.
- First set the plot size according to the bout widths of treatment machinery, and your attitude to hassle at harvest.
- Plots should be two or more spreader bouts wide when testing fertiliser applications by

spinning disc.

- Wider plots are necessary if you want to view treatments with satellite imagery.
- Rotational or cultivation comparisons (e.g. cover crops) normally need larger plot sizes than spray treatments, and are more hassle to replicate.
- Replicate your farm standard treatment at least twice, and ideally replicate all your treatments. The more replication, the more sure you will be of your result.
- Only test the number of treatments that allows sufficient replication within the uniform area available within the field. Avoid testing more than four treatments per trial.

Design of yield-mapping trials

- Plan your harvesting procedure before you finalise your plot size and layout. Aim for at least

two full harvest swaths per plot. Wider plots are best if a precise harvesting plan cannot be guaranteed.

Choosing the right field and area

- Choose a field which is big enough, square enough, and even enough.
- Choose a field with suitable soil type, previous crop, variety, etc.
- Avoid fields and areas with recent differences in management e.g. fields previously split (see

example below).

- Avoid areas with known problems of drainage or weeds (unless central to your question).
- Exclude headlands and areas which include trees, telegraph posts, etc.
- The trial area should be wide enough to accommodate the trial; using a thin field will limit the number of comparisons that can be made.



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- The trial area should be long enough for sufficient yield measurements (ideally >200m) and to maximise the area over which the comparison(s) will be made.

Laying Out the Plots Fairly

Fit with prior patterns of field variation

- Note that 'natural' within-field variation in yield will almost always exceed the expected effects of your treatments, so you need to locate your plots very carefully to be as fair as possible.
- Inspect available satellite images (e.g. on Google Earth) and past maps of yield, soil conductivity, nutrients and NDVI, if available.
- If there is obvious variation, arrange the treatment areas so that comparisons will be fair. Ideally any patterns of variation should run across the tramlines, so that variation is not

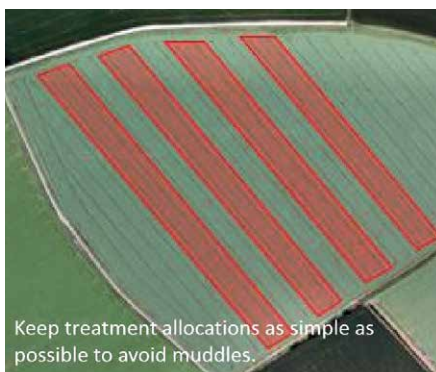


confounded with the treatments.

- Where the likely pattern of yield variability will run at right-angles to your treatments this can be an advantage, as you can see the effect of the treatment across different conditions e.g. soil zones.

Allocate treatments to plots

- Statisticians prefer treatments to be allocated to plots randomly, within blocks of replicates. This is especially important if there is a spatial trend across the treatment lengths.
- There can however be advantages in systematic designs, not least simplicity. We prefer to alternate the standard treatment with the test treatments as above, so that a good estimate of spatial variation can be made, and good comparisons can be made with the standard.



Applying and Recording the Treatments

Mark and record trial and treatment locations unambiguously

- Make a proper record of which treatments were placed where, ideally using mapping software/apps, or at least using a sketch on a field map.
- It is also worth marking the locations of the plots in the field using canes or flags.
- Tell all those that might be carrying out field operations about the trial and its requirements.

GPS for yield-mapping trials

- To accurately analyse yield mapping data, GPS positions of plots are essential for yield data to be correctly assigned to

treatments.

- Your tramline and treatment locations may be recorded accurately on your tractor, but this is often difficult to extract and share.
- Record the GPS co-ordinates of the centre of the tramlines for all the treatment plots where they meet the headlands at both ends of the field.
- Ideally use a proper GPS device with a correction signal (e.g. RTK or EGNOS) as the accuracy of smart phones and sat navs is typically poor (>5m). GPS locations can be displayed in various websites and apps, including <http://gridreferencefinder.com/>

Apply the treatments

- Equipment being used for applying treatments should be calibrated.
- When applying treatments, it is important that only the thing of interest is changed so that you can understand what is having an effect on yield. For example, if you are testing a spray, ensure that the different standard and test treatments are applied within a short time of each other and at the same water volume and pressure.
- Apply all other inputs uniformly over the whole field, so that the comparison of your chosen treatment with the standard is not confounded. It is usually best to avoid variable rate fertiliser applications over the trial area.

Crop Protection

Make explanatory measurements

- Depending on your question, it will usually be worth making some explanatory measures (e.g. of disease or by sampling for nutrient analysis).
- The more measurements you take, the more confidence you are likely to have in the outcome of the comparison you are making.
- Point measurements should be in adjacent positions

along the length of each plot, georeferenced if possible.

- Effects 'to a line' coinciding with the boundary of a treatment can be particularly convincing. Take photos of any visual effects you can see.
- If you are able, it is often worth getting aerial imagery from a drone or plane.
- It is possible to acquire satellite imagery, though free imagery at 20m resolution is unlikely to show treatment differences unless plots are quite wide.
- Spatially referenced measurements (such as drone images) can be analysed statistically to gauge how much confidence you can place in any comparison.
- Keep a dated record of any visual effects of the treatment, or any spatial differences that could affect the results.

Plan for harvest

- Good harvesting is critical for trials whether you are comparing treatments using yield mapping, weighbridge or a yield monitor. Your optimal strategy will depend on the relative widths of plots and combine header, your willingness to harvest discard areas separately, and harvest logistics, e.g. the need to unload on the move.
- Key factors for success are accurate harvester calibration, ensuring full header widths, not cutting across treatment boundaries, and maintaining consistency between plots.
- Harvest the whole field with the same combine on the same day.
- Yield mapping gives the best confidence that treatments differences are real rather than from spatial variation.
- Using a weighbridge gives accurate weights, but you need accurate measures of the area to get good yields
- Simply using the combine monitor for separate plots can give instant answers, but will be affected by measuring the area in non-full swaths, start

and ends of combine runs and shortwork.

Harvesting

Harvesting your trial

- Harvest the headlands first
- Aim to be as consistent as possible between plots. Inclusion of wheelings in the combine swath can depress reported yield by around 0.5 t/ha.
- If not using yield mapping, you must avoid cutting across the treatment boundary in your yield area. If yield mapping, this data will need to be removed from treatment comparisons.



Harvest of yield-mapping trials

- Calibrate the yield monitor according to the manufacturer's instructions. Ideally test the yield monitor against harvested grain weights over a weighbridge.
- Keep to a constant speed and try to harvest the whole trial under the same conditions and on the same day.
- Harvest in line with the tramlines.
- Keep the combine header full wherever possible, and aim to cut at least two full header widths per plot. A cut with standing crop on either side of the dividers will be fuller than cuts with an edge or wheeling to one side, even though the widths may be assumed to be the same. For example, a 30cm difference in actual swath width on a 10m header can give a 3% difference in calculated yield, around 0.3 t/ha.
- Combine direction can also

affect measured yield, especially on slopes or in lodged crops. Extract yield data promptly

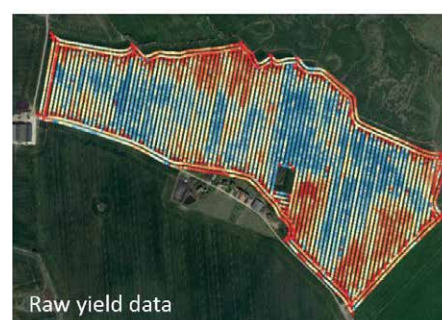
- Each combine system is different in the types of files used to store data and how these can be transferred and viewed.
- However, most yield data can readily be imported into farm management software such as Gatekeeper. The data are then relatively easy to export for comparison and analysis.

Keep good records

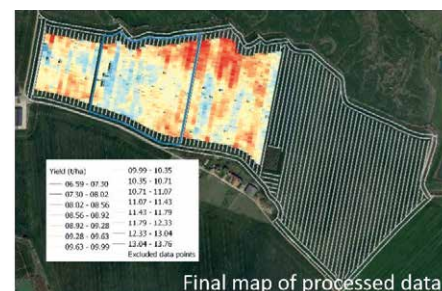
- Record how you harvested the trial, the time and date, and describe any problems.
- Take grain samples from each plot if appropriate, e.g. for grain protein analysis.

Harvest of weighbridge trials

- Accurate measurement of the harvested areas of each plot is essential for accurate calculation of yield. It is best to compare equal lengths of runs of a known harvested width (e.g. two combine runs per plot). Use good quality GPS tools or a measuring wheel to measure the length.
- If weighing grain from different areas of the field, remember that irregular areas are difficult to measure accurately and may compromise your results.



Raw yield data



Final map of processed data

- If measuring harvested area with the combine yield monitor, avoid

non-full headers and adjust width as necessary.

Analysing Yield Mapping Results

Sort out and clean the data

- Remove data from headlands and any values that are clearly aberrant. Various filters are available to remove data where the combine has stopped or changed direction. Also remove data from combine runs that straddled two treatments, or where the header was not full, even if the software has adjusted for width (sometimes an over-correction is applied).
- Assign the yield data to treatment plots and calculate the mean of the cleaned data for each plot.
- Unfortunately, analysing yield map data from trials is not straightforward in many farm software packages. As an alternative, you can try QGIS mapping software, available free from www.QGIS.org.

Assess treatment effects

- Treatment differences will rarely be visually obvious from the yield maps
- Look at the spatial variation in the field and judge whether this was likely to have affected the comparisons.
- Variation in yields of standard plots can indicate whether treatment differences are real. Any treatment effect needs to be bigger than the difference between standard plots.
- If your treatments were associated with different input costs, you can calculate a gross margin for each plot.
- Remember that an absence of evidence of a treatment effect is not evidence of absence – it may be that your trial was not precise enough to detect the effect.

Drawing Conclusions

Check to avoid false conclusions

- Remember that inherent spatial variation in fields is normally larger than any treatment effect you may have imposed.
- Double-check that yields were assigned to their rightful treatments.

- Was the yield map similar to previous yield map(s) without treatments?
- Some spatial variation is inevitable, but this must be assessed and compared to gauge how sure you can be that a yield difference was really a treatment effect.
- How well did yields of replicates agree?
- Consider the counterfactuals and any possible confounding factors.
- Spatial data from other sources, including in-season images and monitoring, should be used with the trial yield data to gauge how likely it is that treatment effects are real.

Share and discuss your conclusions

- If possible, compare your results with those of others. The same trial conducted on another farm or in the subsequent season can build further confidence in the results.

ADAS' Agronomics service

ADAS has developed a process, software and new statistical procedures so those conducting farm trials can reach the right conclusions quickly and easily. This includes;

Geo-processing to define harvest directions, combine runs and distances.

Assignment of data to tramlines, treatments and headland areas.

Data cleaning and processing to remove extreme

outliers and anomalous runs, filter data anomalies, and correct for any offset between opposing harvest runs.

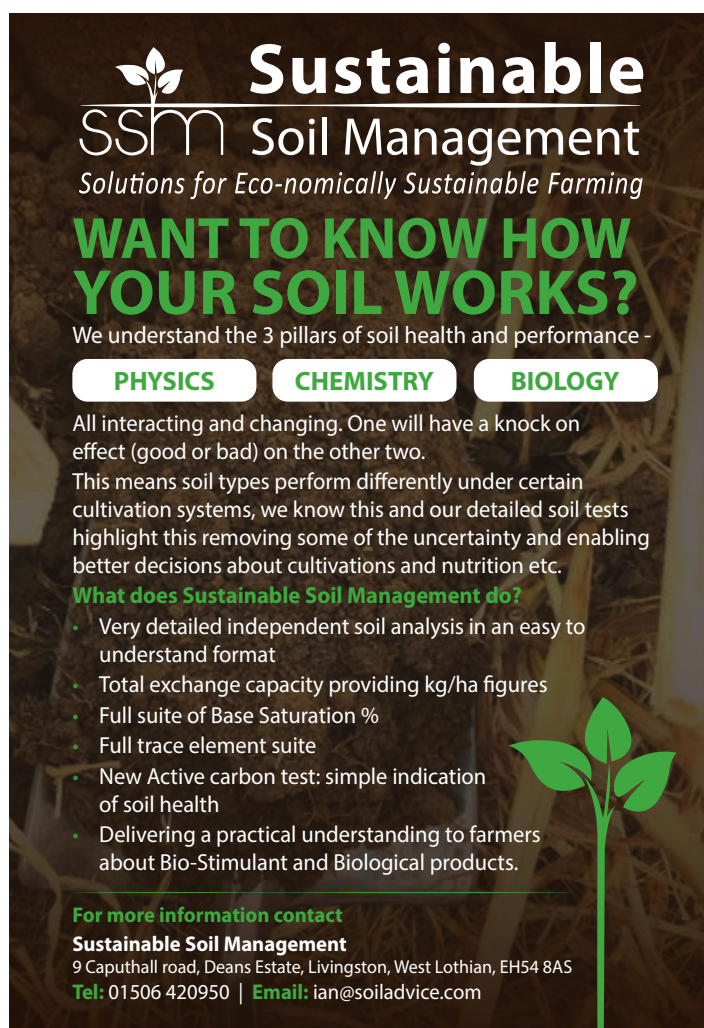
Spatial analysis to model spatial variation both related and unrelated to treatments, estimating the average treatment effect(s) and their uncertainties.

Reporting, displaying yields as maps with a standardised colour key and providing clear conclusions.

Meta-analysis of trial series.

For further information, and queries about analysing farm trial data using ADAS's Agronomics service, contact agronomics@adas.co.uk

This guide has been prepared by ADAS's Agronomics team including Daniel Kindred, Sarah Clarke, Susie Roques, Damian Hatley, Pete Berry and Roger Sylvester-Bradley and they can be contacted on +44 (0) 333 142950



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DALE DRILLS

THE FUTURE OF EFFICIENT CROP ESTABLISHMENT

DALE DRILLS - MEIR AGRICULTURAL

LAMMA 2019 will see the launch of a new low disturbance Soil Conditioner developed by the team at Dale Drills. As a non-drilling piece of equipment, the Dale's decided to launch the product under a new brand, Meir Agricultural, named after owners Tom and James Dale's late maternal Grandfather, Thomas Meir, who worked as an engineer in Teeside in his youth, before taking on the challenge of farming on the plains of Manitoba, Canada in his later years.

The Meir SC has been designed to complement reduced tillage strategies, such as those employed on the Dale's own farm. 'Much of the soil we farm is not naturally self-structuring,' explains Tom Dale. 'Consequently, it is often a requirement to assist nature to provide optimum drainage through the soil, even in a well maintained soil structure.' Having tried many other combinations of subsoiler frames and legs, the Dale's decided that exactly what they wanted didn't exist. 'We were looking



for a reduced surface disturbance, whilst ensuring effective soil loosening through various depths and conditions as well as maintaining a firm finish. Most legs caused excessive surface boiling, whilst many frames positioned legs in ways that prevented effective loosening.'

The Meir's Hardox leg leads are fitted



with a 25 mm wide tungsten point at a shallow angle to reduce surface boil. The wing is 140 mm back from the leading tip, this allows the wing to run in a zone of fractured soil, reducing wear and improving loosening. A shallow angle on the wing further reduces potential disturbance in the seeding zone whilst still ensuring an effective loosening in the compacted area below.

Dale Drills – Have it your way

Dale Drills' award winning range of Eco drills now comes in 4 different layouts each suitable for a different size farm. The tractor mounted Eco-S comes in widths from 3 – 5m and can be fitted with a drill mounted or front mounted hopper.

The Eco-M has seen significant interest since its launch at Cereals 2015



and represents the mid-sized offering available in sizes from 3 – 9m. The M utilises a more orthodox layout than their larger machines with land wheels positioned between the 1st and 2nd row of tines whilst the seed hopper is mounted towards the front of the drill to ensure an even distribution of weight.

The Eco-L is designed for high output drilling and is available in sizes from 6 –



9m. With the seed hopper mounted at the rear of the drill and designed to be wide enough to be filled straight from the average forklift bucket, the company say outputs of up to 200ac/day can be achieved with a 9m drill.

The new Eco-XL was launched at Cereals 18. The improved layout boasts a stretched chassis with a 6.5 tonne hopper upfront, this allows for an uncluttered folding area with widths up to 13.5 meters achievable. Seed delivery is by a pressurised system ensuring both seed and fertiliser can be easily be blown out to the drill extremities. The XL is available in sizes from 8 – 13.5m and is able to fold down to less than 3m wide and 4m high using a 5 section chassis. Sales since Cereals 18 have seen over 40 meters of drill sold in this range.

Additional Options

The versatility of the Eco range doesn't stop at the layout. The drills come as standard with an adjustable row spacing of 12.5 or 25cm, and 50cm as an optional extra. 'Drilling at 12.5cm allows farmers to increase competition,



whilst 25cm reduces disturbance, so the drill can be set to match your preference', said Director James Dale.

A cover crop cutting disc has also been developed over the last 18 months which improves residue flow through the drill, particularly in green covers by cutting a path for the tine to follow. 'The drill 'sails' through thick green cover crops when the cutting disc is fitted, and the tine ensures seed is placed into clean soil. The added benefit of reduced disturbance certainly helps in the battle with blackgrass', added Mr. Dale.

A banded couler has also been developed which fits straight onto the back of the existing seed knife. Seed can be banded to almost 100mm and fertiliser (either liquid or granular) can be applied down the centre of each band and to a slightly greater depth. The couler is made from hardened steel and is fitted with tungsten carbide plates to improve durability.

Dale Drills will be showing their extensive range in Hall 20 Stand 20.76 at LAMMA 2019.

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DALE DRILLS

THE FUTURE OF EFFICIENT CROP ESTABLISHMENT

XAVER: ROBOT SYSTEM FOR PLANTING AND ACCURATE DOCUMENTATION

After successfully completing the multi-year research project MARS (Mobile Agricultural Robot Swarms) in collaboration with the Ulm University of Applied Sciences and the EU research funding, AGCO and Fendt decided to develop the robot project up to series-production readiness for the Fendt brand.

The entire system, including small robots operating in swarms and a cloud-based system control will now be operated under the product name 'XAVER'. 'Xaver' is a traditional Bavarian name with deep roots at Fendt. In the 1930s, the brothers Hermann and Xaver Fendt founded 'Maschinen- und Schlepperfabrik Xaver Fendt & Co.', named after their grandfather Xaver Fendt. Regarding the new robots the name 'Xaver' incorporates tradition and the latest agricultural technologies.

Fendt's new Xaver system uses small robot units operating in swarms and a cloud solution to plan, monitor and accurately document the precise planting of corn. Satellite and data management in the cloud allows navigation around the clock operations, with permanent access to all data. The exact position and sowing time of each seed is accurately recorded. Knowing exactly where the seed has been planted opens up new potential for further processes, since subsequent operations such as crop protecting or fertilising, can be performed precisely at the individual plant.

Planning for the required field, for seeds, seed patterns and -density is carried out via the Xaver app.



The intelligent OptiVisor algorithm plans the robot's deployment based on the entered parameters, and calculates the optimal paths for the units involved and the time required for completion of the job. Software updates for the system can be downloaded "over the air", just as a remote diagnostic can be run conveniently and location-independent via the smart device.

redundant communication help covering breaks in the network coverage.

If a robot malfunctions, the paths of all units are automatically re-optimised, and the remaining robots take care of the work. Additionally, a mixed variety of crops can be planted in the field, since each robot can be filled with different seeds.



Intelligent fleet management

A key element of the Xaver project is the intelligent management of the deployed robots. For example, a Fendt robot system consists of 6-12 units, and can therefore attain an area coverage of around 1 ha/h. Each robot is in constant communication with the control intelligence. Data buffering and

Resource efficiency and soil protection

Thanks to the battery-operated,





highly robust. Their small size and light weight make maintenance easier, and means that the system is intrinsically safe.



electrical motor (approx. 400 W), the low weight (approx. 50 kg), and the autonomous operation, planting can continue round the clock, 7 days a week, even in conditions which conventional machines find difficult, e.g. due to the state of the ground or noise emissions. This increases the productivity and flexibility of the system. In relation to the large tyres, the ground pressure is almost

negligible (approx. 200 g/cm²).

The robots need around 70% less energy to do the same work, and accordingly produce less CO₂ when doing it. Since neither diesel nor oil is required to operate the robots, there is no leakage and there are no local emissions.

The robots are easy to mechanically assemble, do not use complex sensors, and are therefore

If you were at Agritechnica in 2017 then you will have seen the XAVER robots up close and the static demonstrations. For innovative farmers focusing on precision farming they are certainly of interest. Lets hope that more is unveiled at Agritechnica 2019 with regard to when we will actually see this technology on farm, but it certainly sounds interesting and not that far away.

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Best regards John Gilgunn - sent April 6, 2017

“You have a great wee magazine that I look forward to receiving every quarter. I will send you some pictures of our little inventions one day and if you are ever in NZ then look me up.”
Regards Allen Collinson (NZ) - sent April 7 2017

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Best wishes to all readers of Direct Driller *Mike Donovan*



EVENTS IN FOCUS

OVERBURY ESTATE

Mike Donovan writes...

Joel Williams is a familiar face to many with an interest in soil health and biology, and first spoke to a UK farming audience in 2010. The Australian plant and soil health educator has a global audience and Direct Driller magazine caught him at the Overbury Estate in Worcestershire where he joined the estate manager and no-till enthusiast Jake Freestone and also Simon Cowell, a long term no-tiller who farms heavy land in Essex who was voted Soil Farmer of the Year 2018. The day provided a mass of information both in the field and from the podium for farmers thinking of transitioning to no-till as well as others who have already made the change. The event was superbly organised by QLF, quality liquid feeds, who have developed the foliar product Boost which is used by both featured farmers.

Joel provides workshops and consultation on soil management, plant nutrition and integrated approaches of sustainable food production as well as giving soil-based talks for farmers, advisors and others. At university he specialised in plant and soil dynamics and he has a particular interest in managing soil microbial ecology along with crop & soil nutrition to optimise plant immunity, soil function and soil carbon sequestration.

In the last few years he has been working in the UK and Europe with both conventional and organic farming systems, integrating soil chemical & biological assessments and in addition integrating plant nutritional analyses as a joined-up strategy for managing crop production. In the UK he was a headline presenter at the 2018 Groundswell Show in Herts and in the year did two presentations in Herefordshire and others in Sussex and Derbyshire, Haddington and Perthshire in Scotland, Northumberland, Shropshire and Tullamore, Ireland. He has enthusiastic audiences in Australia, UK, Ireland, Netherlands, Latvia, South Africa, Kenya, Canada and the US.

At the podium Joel is a convincing speaker who talks with his hands, while in the field he is often in the bottom of a soil pit explaining what is revealed to an audience around the edge. Soil, its use and misuse, is his passion but the MSc

he is currently doing in Canada is in the wider area of Food Policy, illustrating his belief in the need to acquire a wide knowledge of the whole business of food supply.

Joel has a wide understanding of the issues surrounding soil, the way farmers use it its biology and science. The breadth of knowledge means that he has a suite of soil subjects within his expertise.

"We live in exciting times in farming, as the industrial, ecological and agrarian factors of farming overlap to produce production systems, and the question of ecology is introduced at any part of the spectrum."

The third is ecology which is described by diversity conservation and the ecosystem. This is the leg which Joel considers most neglected.

While the industrial or conventional farming contributes to the deterioration of soil components, including water quality and sustainability, the agrarian system relies on natural processes.

Joel spends time exploring the area between the two, proposing farmers maximise the use of the natural processes which the farmer can harness to substitute for a proportion of artificial inputs.

Plant nutrient sources and supply

There are two basic sources: chemical and natural. Soil health is the provider of natural sources of nutrients, so the farmer who understands the mechanism of soil will have the tools to stimulate natural organisms that improve nutrient production. Soil health equals plant health and vice versa. Plants absorb nutrients fast, foliar feed getting to the roots in about an hour. Farmers using foliar



These stones are part of the reason for the robust machine

products are advised to spray in the early morning for best take up.

Joel explains that the UK, along with many other countries, has a history of over-application of nutrients, and says this is due to a focus on N, P and K and a disregard micro-nutrients and a casual interest trace elements. He explains that all components are needed if the soil's potential is to be made available for the crops being grown. Smaller quantities of micro-nutrients may be needed, but their importance is equal to other elements. Healthy soil with adequate supplies of Mo, Fe, Ni and Co are able to feed healthy bacteria that are able to sequester N from the air as well as creating the right growing conditions for N fixing legumes and clovers. The science applies to all plants, and he stressed the importance of molybdenum.

Tissue tests can mislead. Testing for total N doesn't reveal levels of amino acid and the tests can show an N



There was plenty of interest in the 6m, 11 tonne CrossSlot which has a projected life of 20 years



Jake Freestone explains his soil management system



Joel Williams makes the case for biological systems

deficiency when the actual problem is in the trace and micro elements. Adding N from the bag will be far less efficient

Soil biology is combined with soil physics and soil chemistry in creating a productive medium for crop growth, and Joel underlines the importance of all three, and explains that each has an influence on the other two. Chemical changes affect the physical structure as well as the biological activities; physical changes like compaction affect the biology and the chemistry... Joel focusses on soil biology because it is less well understood than the others.

Most are aware of the huge number of living organisms, from the primitive algae which are the first form of life, to bacteria and fungi, protozoa (the single-celled microscopic animals, which include amoebas, flagellates, ciliates, sporozoans, and many other forms); nematodes; arthropods which include spiders and other invertebrate insects; other insects like centipedes and others; and earthworms. Soil carries billions of organisms which work together in what is called the soil food web, where carbon is the common denominator. Bacteria and fungi break down the organic matter by feeding on it and incorporate it into their biomass. Up the chain and the critters are feeding on organic carbon and excreting it, breaking it down. At the top of the chain are creatures which eat each other producing dung for bacteria and fungi to enjoy.

Mycorrhizal fungi is of major importance for plants as they are attached to the roots and contribute to plant development by being fed the sugars and carbohydrates which are the product of photosynthesis and in return feeding the roots mineral and organic nutrients needed for plant growth. Mycorrhizal fungi exist in nearly all soils and provide a secondary root system for the plant, a wider and efficient

network attached to the plant's roots with spreading spidery arms extending beyond the plant roots. These fungi can increase the plants access to soil volume from ten to a thousand percent, and so increasing water absorption, plant size and production.



Simon Cowell, Soil Farmer for 2018, explains how no-till on his heavy Essex clay has improved many aspects of the job

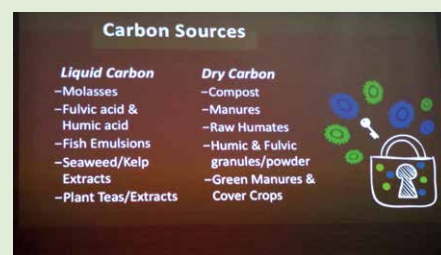
Further up the chain the protozoa

Nematodes are well know to farmers and growers. Root feeding ones feed on the sugars from roots having first punctured the root with a stylus. Beneficial ones scoop up bacteria and feed on it, others feed on fungi having a straw like structure, and others again that feed on other nematodes. Each process excretes waste products which are then available to the the plants.

The process creates nutrients which can be measured and analysed. Some nutrients are highly soluble and almost instantly available to the plant once connected to the root structure. Less available are the exchangeable nutrients which will take a short time to become available. The third category, the insoluble ones, can move down the soil strata and will, in time, change their nature and become available. When a soil test shows a deficiency of soluble nutrient the temptation to add more from the bag is compelling, but in reality the soil may well have enough nutrient, but lack the means of accessing it. More biological activity would bring the nutrients above the root zone and closer to the surface to allocation where they can be used.

Farm tour of Overbury

The group of 90 toured the higher land at Overbury and Jake Freestone explained that the management



Charts like these bring the information together

moved towards no-till in 2003 and has since taken up cover cropping and companion planting. The first field we saw has been no-till since 2012 and undressed Cruse wheat was coming through well. The crop had some Zn and Mg and 15 t/ha of FYM in addition to the pea residue. Blackgrass populations are in decline and the aim is rouse minimal insecticides. One of the visiting farmers named Ken put forward the idea that their neighbours' use of the product provides protection, but Jake's view is that as soil condition improves so the crop condition is raised and so become stronger and more resistant to insect damage. Rotational grass is used to clean land.

They use a soil penetrometer to measure soil compaction and provide some comparative data of soil resistance at differing depths, and on the day of the visit we found that there was little difference between measurements in and out of the tramline. They also measure water infiltration using a drain pipe.

The three tractors and four trailers climbed right to the top of Bredon Hill passing a large area of stoney brash to where the 6m CrossSlot direct drill was parked. Jake explained that the hugely robust machine was designed for New Zealand conditions where farmers were regularly tackling stony ground, and the expense was justified by the expected 20 year lifetime of the machine. The drill can handle four products at a time, with two hoppers with air, so it can do a main crop and granular fertiliser. Two side pods are used for small seeds, slug pellets and other product that is spread at a low rate. The drill weighs 11 tonnes and the tractor 9t, and the fuel is 13 - 15 litres /ha.

Jake's straw policy varies with the field. It is baled and removed before osr because of the slug challenge.

Simon Cowell, judged Soil Farmer of the Year for 2018 provided a

fascinating account of working some of the heaviest clay on the Essex coast. His farming has involved working with soil to improve plant performance, and this has involved numerous trials of ideas he thinks might work. The result is that his growing medium has improved hugely. "The soil has lost its stickiness and it is 20 years since we have applied any phosphate. The farm carried a dairy herd and after each grazing we would put on some more nitrogen, just as we were told to do. Grass now grows as well without the top dressing of N."

Simon explained the plant hierarchy and how their nutritional needs change dependent on their place in the list. Moving the soil composition up the scale through the use of compost has resulted in a noticeable reduction in blackgrass which has been a major problem on these bacterial soils. The compost has reduced the germination of weed seeds and has meant that Atlantis is now working again. Simon says that the no-till system keeps the soil aerobic, while working these soils with tines and power harrows breaks the structure and causes slumping.

"I see the compost heap providing

an inoculant rather than a fertiliser or soil conditioner. The compost provides a home for good bacteria and fungi which then help feed the cash crop."

The compost is mixed with a bespoke machine rather than a fork and the stirring increases both carbon and nitrogen levels. The heap is kept at 70C and is left to stand for a year. He makes the most of horse compost, ditch soil and plasterboard. Fed this way the crops tend to have stronger straw, deeper roots while plots given regular fertiliser have softer tissue making it easier for destructive fungi and insects to attack.

Every field has a 'holiday' by being down to lucerne for three years. The crop goes to local company Dengie crop driers and the plants get a chance to drive their roots deep into the soil - they can go as deep as 45ft and more. While conventional farmers would break up the root network created by these roots, by leaving them well alone Simon preserves the matrix of pores which aid drainage and provide new roots with a highway rich in fungi and bacteria from the rotting roots.

The field surfaces are better able to

carry farm traffic and the need for ultra flotation tyres is now much reduced.

Simon also trialled the effect of fungicides - stopping using them on some fields - and found they were depressing yields. So while they reduced disease they had side effects.

He also has developed his own wheat mix blend, choosing 4 varieties that are unrelated and mixing them prior to drilling. The next year's crop comes from home saved seed, and this has now continued for five years. He was interested in how this mix compared with seed from KWS and was pleased to see his mix performed well. He has done other trials into N and concludes that often the plant needs a combination of trace elements and bacteria in addition to the N feed.

"The processes we are dealing with are far far more complex that is presented in textbooks and by experts."

Simon describes the trials as 'addictive' and the information gained is always worth more than the money spend on doing the work.



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CONFERENCE HIGHLIGHTS CALCIUM'S VITAL ROLE IN **SOIL NUTRITION**



10th October 2018 – At Nantwich Football Club

Calcium has a key role in maintaining healthy, fertile soils and the production of high-quality crops and forages. Yet it is estimated that 60% of UK soils are below optimal levels of pH and calcium, and the importance of this key nutrient is often overlooked.

To help put calcium under the spotlight, granulated lime manufacturer, Calcifert, hosted the UK's first Calcium Conference back in October. The event attracted an audience of more than 100 agronomists, arable producers, soil specialists and livestock farmers; highlighting the wide range of applications that calcium has within the agricultural sector.

Whilst the day's seven speakers tackled a diverse range of subjects – from the practicalities of measuring calcium levels in soil, to interpreting calcium test results – what was clear from all of the presentations is just how important a role calcium has on plant growth and soil biology, and that this should be of significant interest to arable farmers.

Ian Robertson urges detailed approach to soil testing

Agronomist and managing director of Sustainable Soil Management, Ian Robertson, highlighted the need for detailed soil testing before decisions on nutrient inputs are made.

Ian's presentation looked closely at both the importance of calcium to plant health and cell wall development, but also calcium uptake and how much of this vital element needs to be supplied to a plant.

Ian advocates carrying out more than a simple pH, P, K and Mg soil test, as focusing on these elements alone may not be enough to improve soil conditions. The four major cations (Ca, Mg, K, Na) should always be included as part of a test.

Calcium is a major component of any soil test, but a simple PPM result is not enough to inform a nutrient program. A soils Cation Exchange Capacity (CEC) should also be determined to help balance the cations in a soil in order to achieve the optimum soil pH and soil structure. An understanding of both available and total calcium in the soil, which can be matched to crop demand, will



Ian Robertson

improve production and health.

As well as reminding the audience that pH is not the measure of calcium and consideration of other cations was vital, Ian also emphasised the importance of CEC and its relation to soil calcium results.

Ian's overarching message when it comes to calcium recommendations is a straightforward one – a simple calcium analysis will not provide you with all the

NATIONAL ORGANIC COMBINABLE CROPS (NOCC)

By Richard Harding

Organic's potential for whole farm improvements came under focus at the UK's largest organic on-farm event

The 2018 National Organic Combinable Crops (NOCC) conference brought organic and non-organic growers together to hear the benefits organic systems bring to the farm business and the farmed environment. It is noticeable again this year the increasing number of farmers and agronomists practicing Conservation Agriculture who have become regular attendees.

Held by Organic Farmers & Growers at Green Acres Farm in Shifnal near Telford, Shropshire. The day took place on another extremely hot July day, NOCC featured experts from across the production and supply chain.

The day began with first speaker NIAB's head of farm research Liz Stockdale, who discussed the organisation's £1m, five-year project to improve understanding of soil health and biology as part of a whole eco system management. Liz is someone who has a natural gift to make a complex subject easily understood by all.

It is always welcomed by organic and conventional growers alike to reinforce the importance of soil biology as the driver of a sustainable farm business. Joel Williams an independent plant and soil educator followed Liz in echoing the importance of soil as a complex

ecosystem and drilled down further into the integral relationship between the soil biology, chemistry and physics. Stating "they all have equal importance".

As with any farm system effective marketing is crucial. Lawrence Morden of seed merchant Walnes, joined the line-up to discuss the company's project with farmer collective Organic Arable to develop plant varieties which will thrive equally in low-input regimes or an organic systems.

This year's renowned NOCC lunch was provided by Kimberley Bell of the award-winning Small Food Bakery. As a conventional agronomist it is very noticeable the stark difference between the quality and care taken over food at organic events compared to conventional grower meetings. Kimberley and her team, who won Best Food Producer at the previous month's BBC Food and Farming Awards, included many of the key crops grown on the farm in their menu to demonstrate the bakery's approach to reconnecting food with the farmers who produce it.

The day was rounded-off with a farm walk, looking in detail at NOCC host Mark Lea's business, which includes a green waste composting operation. It

was a chance to look in detail at all the crops being trialed on the farm. These including wheat varieties Evolution and Spyder, KWS Basset, Crispin, Montana and Siskin, as well as the results of a bi-cropping trial of peas and triticale. The triticale being used to hold the peas up making harvest easier and improving the overall quality of the peas.

Mark explained "We're always interested in trying different things on the farm, and hosting NOCC has given us even more motivation to experiment with what we trial here".

"Being organic has opened up a huge number of opportunities for us, not just in terms of what we grow and our production cycles, but also in how we manage the land to ensure that it is in the best possible state to produce food."

OF&G chief executive Roger Kerr explained that NOCC - which is now in its 11th year - has long been the highlight of the organic farming calendar.

With so much uncertainty on the horizon, all farmers could benefit from learning more about the developments and opportunities offered by this system.

"A profitable and successful farm businesses need to be resilient in terms of economics, agronomy, and the environment," he says. "Organic farming simultaneously offers all of these and in the face of major challenges, farmers need to build greater resilience into their businesses."

Whatever your views on Organic farming NOCC always provides an opportunity for farmers to come together and learn from each other whatever their system. It's also a place to get new ideas and leave inspired by what is possible when you work more closely with nature. However, it is also a cautious reminder of why many farmers are addicted to a solution in a can. Here's looking forward to next year and I hope to see you there.



BASE UK FRENCH FARM TOUR NOV 18

By David White

A predicted slowish drive down the M11/25/20 turned out as predicted.

Richard Harding my observer and I had left in plenty of time to catch our EuroTunnel train so a coffee and croissant in the terminal building we slipped under the channel on route Dieppe.

Day one had been reserved for travelling down but rather than fill it with a long lunch stop at Le Touquet I had researched the resting places of some family members killed in the Great War so I could pay my respects.

Blue sky and 17 degree temperatures made for a very pleasant drive across to Aubry our first cemetery destination. November 1st was All Saints Day in France which meant the town cemetery was still brightly decorated with Chrysanthemums. After somewhat of a struggle we found a pair of simple graves that had been immaculately looked after by the Commonwealth War Graves Commission in the decades since the war, as they will be going forward.

Next stop Louvencourt, a CWGC cemetery, again immaculately tended on a quiet country lane which looked out over the peaceful French countryside, very different from what the scene would have been 100 years earlier. A plaque detailed the history of the battles on the Western Front and highlighted areas that had been fought over several times as each side gained a temporary advantage. I laid a poppy, left a note in the book of remembrance and we headed off for our overnight stay, covering miles in minutes that had been hard fought over for years ten decades earlier.



If you have family members who fought and fell in either of the wars a visit to their resting place is something you should try and do. My two relations, both young men were sadly killed in the last few months of the war. It was a special thing to be able to visit their resting places 100 years on in memory of their sacrifices.



Frederick's Winter peas

Normandy

The French countryside in this area was punctuated by fields containing either just mustard that was being flailed and disced, through to a few with very varied cover crop mixes. Although spade-less we could not resist getting out to have look at what was growing in some of these fields. As some of the species growing we didn't recognise Richard did he usual taste test to see if we were looking at turnips or radish, hot after taste so radish! Lots of questions for Victor about French farming regulations when we meet tomorrow.

We dined very well in Dieppe, this was France, and after a comfortable night in a sea front hotel and a good continental breakfast we headed along the coast road through some lovely seaside villages to meet great friend of BASE UK Victor Leforestier at his first field. This land, just in from the Normandy coast is very productive, capable of growing vegetables and roots and as evident from the operations being carried out, the plough and power-harrow drills clearly still favourite. These

farms can produce 10t/ha of wheat quite easily, why change? The rules governing greening in France allow for destruction from Nov 1st so there were discs, ploughs and drills turning mustard cover into wheat everywhere. We have the impression that many farmers were "greening" because they had to, not because they could see the wider benefits.

We were greeted by a very different scene when we arrived at Victor's field, no mistaking that we were in the right place (see pic 1). Victor is somewhat unusual in the world of Conservation Agriculture in that he is working with three root crops in his rotation, beetroot, potatoes and sugar beet, but still extensively using cover crops to build SOM and biology. He strip-tills for sugar beet but practices fuller cultivation for beetroot and potatoes. He rotation is built around flax, widely grown in Normandy, but also grows wheat and barley and we saw some impressive clover "understory" in some barley stubble. Initiatives like this and cover crops growing in potato ridges





Julien's wheat

show what is possible in a non 100% combinable crop rotation.

Victor had his tele-handler at the field to dig some soil profiles which demonstrated very well how he'd built up the organic matter near the surface and how roots had taken advantage of the impressive worm holes.

We enjoyed a very relaxed (this was France) lunch at Les Fregates Restaurant in a little coastal village Veulettes-sur-Mer, then escorted by Victor who was acting translator for the afternoon visited Emmanuel Bellest who farms at Paluel. Emmanuel is also growing sugar beet in his rotation using strip-till with autumn sown cover crops, also like Victor he had the most amazing fields of multi species cover crops in flower and was using compost amendments and carrying white clover companion established in rape through several years of his rotation.

You don't get to visit some of the very best BASE France farmers without clocking up a few miles so on leaving Victor and Emmanuel we headed 150 kms west to Amiens for our second night. Our town centre Ibis didn't promise to much from the



Julien's wheat soil

outside but the rooms were clean and comfortable (to comfortable for one who slept waaay to well...), it had a bar and secure underground parking, Result! So as to not dilute the memory of the exquisite dinner we'd had in Dieppe, and also to keep the trip on budget we went for a less upmarket restaurant this time, we reasoned that as some locals were dining there it should be ok but the laminated menus should have been a clue to the fare we were about to have, if you value steak by how much chewing it takes to be able to swallow it we got great value!!!

Early to rise (for most of the team) resulted in a quick breakfast and check-out then 100 km drive south to the beautiful estate farm of Frederic



Victor's first field

Remy. We were greeted by Frederic and our host for the afternoon Julien Senez at a very impressive machinery shed and grain store. I had my usual attack of French trailer envy, gosh they do have fabulous trailers, and the Fendt on a new Horsch Avatar drill just off the do some contract work for a neighbour equally impressed. But as we know its not all about the machinery so over a coffee and croissant we enjoyed a very informative short presentation on Frederic's farming history at the estate he manages and journey into Conservation Ag. Both Frederic and Julien had a good enough command of English for us to have a good understanding of what they are striving for on their farms, Conservation Agriculture is of course an international language.

Frederic does indeed have a very beautiful farm, just 14 kms from

Paris he can see the Eiffel Tower from his tractor cab. The farm with its woods and glades, lake, beautiful old buildings, a small estate church and Castle make it the most amazing place to live and work. Frederic's fields were immaculately farmed too, crops edge to edge even, save for a wheat headland grubbed up by wild boar, and his attention to detail and huge enthusiasm for how he is now farming and the success he's had over the last five years was infectious.

Lunch time again and this time courteous of Julien in a gorgeous conservatory at a golf club near his farm at Vignemont. Julien has been zero-till for eight years and in that time has done around 60 trials on his farm to work out how to improve his soil to give increasing and reliable yields. Standing in a flowering cover crop that was around 5 feet tall made up of a 15 way mix looked to be cover crop perfection. But due to the high carbon to nitrogen ration of the crop residue in Julien's wheat, barley and grain maize rotation he wanted to increase the nitrogen element so this cover was about to be terminated and then have a high % legume mix drilled into it to provide fresh new growth for the next 5 or so months before maize planting time. The soil in this field had around 40% clay content but had the colour



Victor's potato ridges

and structure of something you would find in a grow-bag at a garden centre. As France has already lost neonic seed dressings on cereals we saw many later planted crops which helped offset the need for early insecticide sprays as did planting into "the green" with the cover crop



Emmanuel's cover crops

vegetation hosting some of the aphids instead of the cereal plants. Our final field stop was at the bottom

of a sloping field which had a newly planted agri forestry scheme on it to help overcome drainage issues.

Some common themes on the very innovative farms we visited were; improving soil structures and nutrition, the use of cover crops in a rotation with roots, companions with rape, clover lasting through 2 or more crops in the rotation, strip tillage, very dense diverse cover crop mixes with investment in seed much higher than would be considered in the UK, the importance of on farm trials and time spent on research plus visiting other farms to build a personal knowledge base, the reduction in inputs, machinery labour and tractor hours that Conservation Ag brings to a farming business freeing up time for those farmers to spend doing other things, enriching their lives.

On behalf of the group I'd like to thank Victor @VictorHolistic Julien @Senez8 Frederic @fredericremy95 and Emmanuel Bellest for their hospitality, generous time given and knowledge sharing that made the trip so worthwhile.



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DISCS VERSUS TINES AT PETWORTH MONITOR FARM

AHDB's Petworth Monitor Farm group reignited two popular debates at their recent meeting (18 October 2018): discs versus tines and 'to till or not to till'.

The Monitor Farm group is hosted by Mark Chandler at Moor Farm in West Sussex.

Mark and the other farmers in the group wanted to see how different levels of cultivation and types of drilling affected his first wheat crop, following beans.

In a normal year, Mark would cultivate behind the combine with a Simba SL600 cultivator running LD legs and points. He would usually use an LD subsoiler and carrier disks on compacted areas or tramlines, before drilling with a Horsch Sprinter Drill or Amazone Cayena low-disturbance tined coulters drill.

Paul Hill, AHDB Knowledge Exchange Manager, said: "Does Mark actually need all the machinery he has and can he get away with doing less tillage, so saving time and money? We looked at these questions and more during the Monitor Farm meeting."

The experiment at Moor Farm includes:

- Six plots, 2ha each, two tramlines wide
- Three plots undisturbed
- Three plots cultivated
- Simba SL cultivator straight after combine
- Vaderstad Carrier Disk
- Weaving LD
- Half of each plot was drilled with Skyfall wheat to a depth of 2.5cm with a Horsch drill (tines) and half with a Sky Easy Drill (discs).

At this stage in the season, Mark and the group assessed the different plots by digging pits with soils guru Philip Wright. These pits were compared with un-moved ground in a neighbouring field which had generally very good soil structure.

Paul said: "During the meeting, perhaps the most crucial topic we covered was

how to dig a soil pit correctly. It sounds simple, but if not done right it could make it extremely difficult to analyse your soil structure properly."

Mark found that looks can be deceiving, early on in the season.

He said: "The cultivated plot, although it looked good, was over-cultivated because actually the baseline soil structure was ok. But by cultivating, we'd made the top four inches too fine which held the moisture up. It sat wetter and didn't walk as well.

"But the unmoved ground which we'd disc drilled was cosmetically poor but actually the soil structure under the surface was good, with good water penetration. Although it's very early to judge the emergence, the rooting depth was looking good."

Throughout the growing year, Mark will be measuring seed germination, plant counts and, finally, yield.

Paul Hill said: "This kind of measuring can be done with the AHDB Wheat Growth Guide. The Guide gives farmers a great baseline to compare different approaches against. It's also a good idea to repeat the same on-farm tests over a number of years."

Mark said: "The key so far, we've found, is to be versatile and make each decision according to the conditions in the field. Our soils are quite variable, so our management approach needs to be variable too, although this does take more time. We need to fine-tune our decisions and pay close attention to the soil."

What's next? Over-wintered stubble before barley. Ordinarily Mark would cultivate the field and spring crop for black-grass control. The soil doesn't need working, so he's looking at keeping the surface cultivation as shallow as possible, but enough to get a black-grass germination.

Find out more about the Petworth Monitor Farm at cereals.ahdb.org.uk/petworth or contact Paul Hill on 07964 243699 or paul.hill@ahdb.org.uk



Mark Chandler

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PRIMARY CULTIVATION AND WHEAT YIELDS – LONG-TERM WORK AT NIAB, LESSONS FROM STAR AND NFS

By Nathan Morris, Elizabeth Stockdale, David Clarke - NIAB

Long term findings from field-scale experiments (STAR and NFS) show that while yields with non-inversion tillage are similar in most years to yields with ploughing, when decreased costs of labour and fuel are factored in, gross margins under non-inversion tillage were better than under ploughed systems. Hence non-inversion tillage is advocated under 'normal' conditions.

The influence of primary cultivation method on crop yields will no doubt continue to cause debate, but long-term findings from the STAR (Sustainability Trial for Arable Rotations) and NFS (New Farming Systems) projects are giving some hard evidence of impacts across seasons and soil types. The long running STAR project in Suffolk (medium/heavy, clay loam soil) and NFS studies at Morley in Norfolk (medium/light, sandy loam soil) started in 2005 and 2007 respectively. Both studies therefore allow us to study impacts over the long-term and have allowed the impacts of the tillage systems to become established. NIAB co-ordinates and manages these trials but they are funded by a number of charities. The Morley Agricultural Foundation (TMAF) and the JC Mann Trust provide continued support for the NIAB New Farming Systems projects; the Felix Cobbold Trust and, historically,



Cultivating a plough plot on the New Farming Systems cultivation trial in 2014.

the Chadacre Agricultural Trust provide support for the STAR project.

The STAR and NFS projects are field-scale trials using farm scale equipment and techniques with

fully replicated large plots. The experiments have the same primary cultivation treatments; however, the difference in soil type between the two sites provides an important contrast when considering tillage impacts. The proportion of particles of different sizes (soil texture) that make up the soil have a large impact on the soil structure and properties such as trafficability and workability. For example, clay soils usually have more small pores than sandy soils and these can hold on to more water for longer. Soil structure results from the interaction of the mineral particles (sand, silt and clay) with soil organic matter as they aggregate together to form the crumbs, blocks and other aggregates that we see when working the soil. In some ways, it is the gaps (pore space) between these aggregates that is the most important part of structure as the pores control the balance of oxygen and water available to plant roots and soil organisms.



The STAR trial from the air. This highlights a 36m x 36m plot and the 4 rows of plots; the experiment has 48 plots in total



Impacts of autumn cultivation treatment on soil structure and distribution of the crop residues of the previous winter wheat shown in spade-assessment (VESS). Soil conditions were wet to very wet at the time of sampling in April 2018.

Cultivation has a key role in shaping the soil structure. However, plant roots and some soil organisms (known as 'ecosystem engineers') also change the structure of soil by moving through the soil, moving soil particles around and extracting water. Along with a range of physical (drying-wetting) processes, these biological interactions have a central role in soil structure development and create micro-habitats for other soil organisms; in temperate agro-ecosystems, earthworms are very dominant within this group.

In the STAR and NFS trials we are comparing 3 contrasting primary cultivation practices: inversion (c. 25 cm plough) and non-inversion tillage (using the subsoiler / disc-based combination, e.g. Sumo Trio) set either deep (c. 20-25 cm) or shallow (c. 10 cm). These systems are used typically for primary cultivation each year to give the three main treatments. In addition, each study also has a treatment which allows a 'managed approach' where the cultivation system used changes with study, season and crop. The annual cultivation decision in these treatments is based on soil conditions, field assessments, previous cropping, weed burden and local best practice (see Table 1 and 2). Secondary cultivations (e.g. power-harrow, press) are used as needed on a treatment by treatment

basis.

The specific crop rotations used also differ between the sites, however, in both studies rotations employ only combinable crops and include regular winter wheat alternating with combinable break crops.

Winter wheat yield

In both STAR and NFS the regular cropping of winter wheat in the rotations provides a unique opportunity to examine the impact of primary tillage on long term performance of first wheat yields in large scale fully replicated studies. Statistical analysis has focussed on the 'consistent systems' (where treatments have remained the same over this time period). Winter wheat yield data for from harvest years 2, 4, 6, 8, 10 and 12 of STAR project are presented in Table 1. Analogous data from harvest years 1, 3, 5, 8 and 10 of the NFS Cultivations study are presented in Table 2. In both studies, winter wheat yields vary markedly with the season; i.e. year has a statistically significant impact on yield.

In terms of the impacts of tillage systems, there is no clear pattern in all years. Considered on average across seasons, in STAR there is no difference in the yield of the different primary tillage systems. In NFS taken across all years, there is a significant reduction in yield (-4%) in the shallow non-inversion systems

compared to the other approaches; however, the difference is not significant in any individual year. This is possibly associated with the lighter soils being more prone to loss of structure where some rectification / management is not used. Overall these findings suggest only small percentage yield reductions with shallow tillage (cf. plough systems) indicating that wheat yields are relatively robust with respect to the tillage approaches assessed on these sites. More data analysis and crop modelling may help to explain the differences in the treatments year by year e.g. in terms of the direct impact on seedbed quality and consequent establishment.

At STAR the managed approach to cultivation gives a slightly higher average yield compared with the treatments where the primary cultivation techniques are applied consistently. At NFS yields are 4% lower under the managed approach compared to deep and plough tillage, possibly as a result of the high proportion of shallow tillage used (3 out of 5 years).

Winter wheat margins

When considering gross margins, both STAR and NFS non-inversion treatments (shallow and deep) resulted in greater margins in first wheat crops compared to the plough. For deep non-inversion treatments this benefit was 6-7% and for shallow non-inversion treatments gain was 1-4%. Margins were also increased in the managed approach compared with the ploughed treatments. However, in addition to margin it should also be noted that ploughing would have also resulted in slower speeds of working (cf. non-inversion tillage systems); this would potentially improve a farmer's capacity and hence ensure timeliness of operations over the total farm area. This is potentially of greater importance than small differences in rotational margin.

Other impacts

In soils under non-inversion tillage, we found increasing tightness in

soils in the upper subsoil; however we also sometimes found large improvements in soil physical conditions over a growing season driven by the growing crop. Where there were no changes in the organic matter inputs, there were no gains in carbon storage over the whole soil profile under non-inversion tillage (compared with ploughed systems). However, with non-inversion tillage, organic matter becomes more stratified in the soil with higher amounts in the surface soil and lower amounts at 20-25 cm compared to ploughed plots.

Currently herbicides are managing the weed burden on all treatments effectively – however, this year we are monitoring some un-treated areas to assess the role of the primary cultivation strategies on the weed seedbank.

Overall, the work in these studies and others is confirming that alongside decisions about primary cultivations, farming systems that support the biological processes of structure formation and increasing soil organic matter content have been shown to help create resilient soil structures that can both

absorb heavy rainfall and hold water in drought; however, there is still a way to go before we have fully uncovered the mechanisms supporting structural resilience.

Acknowledgments and thanks are extended to The Morley Agricultural Foundation (TMAF) and The JC Mann Trust for their continued support of the NIAB New Farming Systems programme; also to The Felix Cobbold Trust and historically The Chadacre Agricultural Trust for their support of the STAR project.

Tillage	Mean yield by tillage treatment (t ha ⁻¹)						Mean yield and margin data			
	Year 2	Year 4	Year 6	Year 8	Year 10	Year 12	Mean yield (t ha ⁻¹)	Yield (% of plough)	Margin (£ ha ⁻¹)	Margin (% of plough)
Plough	8.64	8.51	6.83	8.61	11.64	11.13	9.23	100	607	100
Deep	7.78	9.00	7.40	8.30	11.69	10.92	9.18	100	642	106
Shallow	7.52	8.80	7.32	8.01	11.62	11.60	9.14	99	648	107
Mean	7.98	8.77	7.18	8.31	11.65	11.22				
P value	P<0.0001	NS	P<0.05	NS	NS	P<0.01	NS			
LSD (t ha ⁻¹)	0.45	0.42	0.49	0.57	0.24	0.45	0.98			
Managed (Tillage Rotation)	8.10 (SWDWSAPC)	8.83 (PWSAC)	6.83 (SWSDAC)	8.63 (DWSCSA)	11.75 (SWPSDAC)	11.76 (SWSAC)	9.32	101	656	108

Table 1. Yield (t ha⁻¹) and margin (£ ha⁻¹) data for winter wheat across the tillage treatments on medium/heavy soil (STAR) in years 2 (2006/07), 4 (2008/09), 6 (2010/11), 8 (2012/13), 10 (2014/15) and 12 (2016/17). Cross season analysis for tillage is as presented in the table; in the full statistical analysis there were always very highly significant differences between years but there was no interaction between 'treatment' and 'year'. The average yields for 'managed' tillage are presented for comparison with the primary cultivation method (S= Shallow, D= Deep and P=Plough) used for each rotation in the trial (W=Winter break crops, S=Spring break crops, A= Alternate fallow and C= Continuous wheat).

Tillage	Seasonal yield data (t ha ⁻¹)						Mean yield and margin data		
	Year 1	Year 3	Year 5	Year 8	Year 10	Mean yield (t ha ⁻¹)	Yield (% of plough)	Margin (£ ha ⁻¹)	Margin (% of plough)
Plough	12.75	8.26	10.41	10.70	9.86	10.40	100	917	100
Deep	12.55	8.17	10.54	11.27	10.02	10.51	101	969	106
Shallow	12.30	7.42	10.48	10.45	9.44	10.02	96	918	100
Mean	12.53	7.95	10.47	10.81	9.77				
P value	NS	NS	NS	NS	NS	P<0.001			
LSD (t ha ⁻¹)	0.30	0.77	0.21	0.68	0.54	0.17			
Managed (Tillage)	12.37 (S)	7.69 (D)	10.41 (D)	10.61 (S)	9.61 (S)	10.14	96	937	102

Table 2. Yield (t ha⁻¹) and margin (£ ha⁻¹) data for winter wheat and tillage on medium/light soil (NFS) in years 1 (2007/08), 3 (2009/10), 5 (2011/12), 8 (2014/15) and 10 (2016/17). Cross season analysis for tillage is as presented in the table; in the full statistical analysis there were always very highly significant differences between years but there was a very significant interaction between 'treatment' and 'year'. The managed approach yields are presented with the primary cultivation method S= Shallow, D= Deep and P=Plough.

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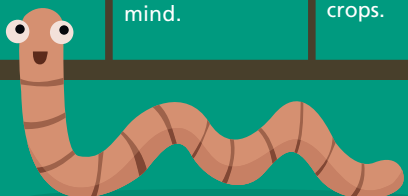
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MEDICINE'S GONE FROM INVASIVE TO KEYHOLE, FARMING FROM KEYHOLE TO INVASIVE

Based on Interview with Dr John Baker, CrossSlot New Zealand.

Medicine has made quantum leaps in research, treatment and surgical procedures in recent years – now it's time for arable farming to follow suit.

Where medicine has moved from invasive to keyhole surgery, agriculture has gone from keyhole to invasive farming, resulting in the depletion of quality soil and contributing to global warming.

International soil scientist, John Baker, says medical science, since last century, has learned to operate on people without disturbing anything more than the immediate part of the body being replaced or repaired.

That meant the body wasn't violated unnecessarily as surgeons identified the problem area.

"This quantum leap resulted in significant improvements in survival rates, healing times and post-operative stress," John Baker says.

"Medical science is leading the way and continues to strive for improvement. Why isn't agriculture doing the same?"

Dr Baker acknowledges that aspects of farming such as GPS guidance and precision farming have shown advances in accuracy, but the most fundamental task of all – seed sowing – is millennia old. Arable farmers are still sowing seed with the same method that Jethro Tull invented in 1701.

He explains our first farmers in Biblical days poked a hole in the ground and sowed a seed – an early form of keyhole surgery – but when someone shackled a primitive plough to a bullock, they started practising invasive farming.

"The idea of the plough was to bury the weeds and loosen the soil to make it soft so they could create a trench and deposit the seeds more easily. Today farmers are still ruining the soil using the same system but

with more sophisticated machinery," he says.

Every time any form of tillage tool opens the soil, it releases carbon dioxide into the atmosphere which contributes to global warming. About 20 percent of atmospheric CO₂ results from the world tilling its soil each year. It also loses humidity, essential for seeds to germinate and destroys microbes and earthworms which maintain the health of the soil.

Dr Baker points out that this is not how nature intended it to be done.

He explains that, in nature, most deciduous plants flower first, then form leaves. At the end of summer the flowers become seeds which drop to the ground followed by leaves. The end result is that seeds are covered by a mulch of dead leaves which maximises their opportunity to germinate and sprout new seedlings.

"But farming hasn't repeated nature's lesson. Instead the leaves are buried or burnt – both of which cause more carbon discharge than the soil gains – and seeds are sown into bare soil without the benefit of the rich, decaying organic matter around them," he says.

"Just as medical science has continued to challenge and improve its surgical procedures to care for the health of people, agriculture now needs to do the same for the health of the soil."

Dr Baker says primitive man had a better solution when he poked a stick through the debris on top of the ground to plant a seed. Without realising it, he minimally disturbed the soil, preserved the humidity, retained the microbes and gave the seed the best chance to flourish.

While conventional tillage or ploughing increased cropping, its constant rape of the soil has had a damaging global effect. Most of it has gone unnoticed until we woke up and realised that the projected 50 percent increase in the world's population by 2050 will result in insufficient food to feed everyone and famines in some areas.

Low-disturbance no-tillage, which, like rugby football, was invented in Great Britain but refined in New Zealand, uses a method of keyhole farming that primitive man perfected centuries ago.

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"Arable farmers now need to forget about how seeds were sown in the last few centuries and take the quantum leap to do it right from now on," he says. "Fortunately leading farmers are already doing so."

"While a strong humanitarian reason is to preserve our planet, the most compelling reason for besieged farmers is that it'll make more money for them."

UPCOMING EVENTS

3rd and 4th January 2019 8th and 9th January 2019	Oxford Real Farming Conference - http://orfc.org.uk/orfc-2019/ LAMMA 2019 - www.lammashow.com/
8th to 11th January 2019	2019 National No-Tillage Conference - Indianapolis USA - www.no-tillfarmer.com/events/185-2019-national-no-tillage-conference
22nd January 2019	AHDB Monitor Farm Event - Newton Lodge Farm - https://cereals.ahdb.org.uk/northampton
22nd January 2019	Grain marketing - what does the miller want? - https://cereals.ahdb.org.uk/northampton
28th January 2019	Reducing the Fertilizer Budget - www.notill.org/events/reducing-the-fertilizer-budget-integrating-nutrition-and-biology-toward-plant-and-soil-health
29th and 30th January 2019	23rd Annual Winter Conference - www.notill.org/events/23rd-annual-winter-conference
5th February 2019	NIAB TAG Leek Agronomy Open Day 2019 - www.niab.com/shop/civicrm/event/info?reset=1&id=2857
5th and 6th February 2019	BASE AGM Conference at The Haycock Hotel, Wansford, Nr Peterborough.
6th February 2019	Strategies for sustainable soil management - www.artistraining.com/soil-water
7th February 2019	Essentials of good soil management - www.artistraining.com/soil-water
13th February 2019	AHDB Monitor Farm Event - Newton Lodge Farm - https://cereals.ahdb.org.uk/northampton
13th February 2019	NIAB TAG Outlook Conference 2019 - https://www.niab.com/shop/civicrm/event/info?reset=1&id=2846
7th May 2019 -	NIAB Herbage Crop Inspectors Course - https://www.niab.com/shop/page/training-and-events
21st May 2019	AHDB Monitor Farm Event - Newton Lodge Farm - https://cereals.ahdb.org.uk/northampton
12th & 13th June 2019	Cereals 2019 - https://www.cerealsevent.co.uk/
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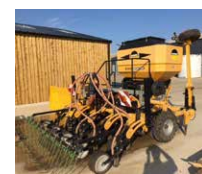
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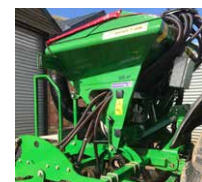
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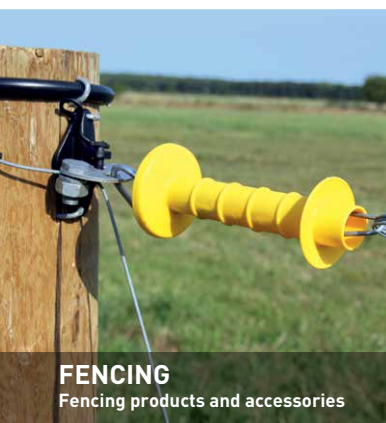
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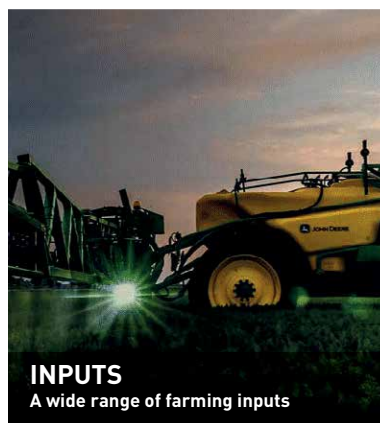
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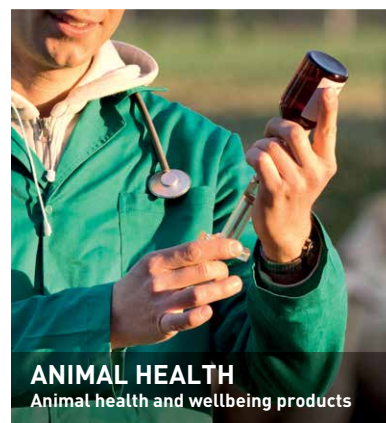
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