

ISSUE 1 | MARCH 2018

DIRECT DRILLER

MAGAZINE

THE FUTURE OF YOUR SOILS

What needs to change IN FARMING

ALSO IN THIS ISSUE

Secrets of their
success in no-till **Page 11**

How to start direct
drilling for £8,000 **Page 20**



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INTRODUCTIONS

MIKE DONOVAN

Welcome to Direct Driller, the UK's first magazine devoted to no-till. Farmers worldwide are learning and taking up the techniques of direct drilling and no-till, and I am delighted to be asked to edit this knowledge based publication focussed on techniques and practice.

My fascination in direct drilling was cemented in 2012 by a YouTube video 'Undercover Farmers', 28 inspirational minutes. It shows how regular farmers have changed to natural soil regeneration through cover crops, crop rotations, the control of soil compaction and nurturing soil biology. The presentation was exciting, made so much sense, and I decided to incorporate the subject into my writing expertise. No-till opens a new agricultural era, and one powered by hands-on farmers across the globe. Linked by internet forums and websites, farmers can, for

the first time ever, share their own ideas independent of suppliers. The pursuit of low cost, biologically sound methods reflects the approach of my own farm journalism since 1992 and Practical Farm Ideas.

We are on the cusp of a major revolution based on soil management, biology, and unlike other major developments such as the use of fertiliser, plant breeding and chemical control, the science and practice here is in the hands of farmers, such as you, the reader. The whole science of soil and its biology has been allowed to languish and it is farmers who are successfully finding the way forward. The scientific community has an important contribution, and the hope is that these pages will direct them and show the areas of research and knowledge.

Government, similarly, has an important role to play both in matching science spending with the needs of the industry and making the techniques accessible to the whole farming community.

It is perhaps no surprise that it took a hands-on farmer, Clive Bailie, to take on the challenge of publishing this magazine for UK farmers, and it is perhaps worth recording it was 1972, 45 years ago, that American farmers got their first sight of no-till in print through Frank Lessiter's No-Till Farmer magazine, from Brookfield, Wisconsin.



RICHARD HARDING

Everything I do is driven by a passion to produce great tasting, healthy and nutritious food. I believe we have to go beyond sustainability to being truly regenerative and see agriculture as an integral part of a circular economy.

An unashamedly but realistic eternal optimist at all times seeking out new and better ways of producing food. I feel very lucky to have grown up in Sidmouth, East Devon and after studying Agriculture at Harper

Adams now work as an agronomist passionate about working with innovative rural farm businesses across the South of England and beyond. At the core of future proofing the rural farm business is knowledge transfer and

I feel very proud to be working with the team at Direct Driller Magazine to cut through labels to bring stories of food producers and production systems that start with the soil.



CLIVE BAILYE

10 years ago, I set out on a journey to change the way we farmed to a more sustainable and financially viable way. The zero-till and conservation system that we have since adopted and evolved has been truly transformational to our soils, local environment and importantly our farms financial performance.

Gaining the knowledge and new management skill required has not always been easy, I found UK agricultural media lacking in the detail and depth of knowledge I needed when making such fundamental changes so looked abroad and to

the internet to learn from others experience.

Direct Driller hopes to bring together agronomic and mechanisation expertise and experience from around the world and is a result of my long-term belief that there is no better way to learn than from the experience of others.

Soil is key to our success as farmers, understanding it better and managing it sympathetically brings massive benefits and long-term attitudes towards food production and environment that can no longer be ignored.

It is this knowledge transfer that is key to success when adopting new systems and I hope that this

magazine is yet another step forward to help others make the kind of transformation to their farming business that I have.



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**DIRECT
DRILLER** MAGAZINE

THE FUTURE OF YOUR SOILS

FARMING WHAT NEEDS TO CHANGE

Mike Donovan reviews the seminal Hugh Bunting Memorial Lecture given by Professor Amir Kassam titled The Future of Farming: What needs to Change?

The audience learned that, in the opinion of the professor at any rate, it was quite a lot. His concern is that agriculture has moved dangerously off course onto a path of declining productivity, and at the same time has negative impacts both ecologically and socially.

"The intensive tillage-based interventionist farming with its high and addictive dependence on agrochemical inputs and heavy machinery -- is no longer fit to meet the agricultural and rural resource management needs and demands of the 21st century."

His concern reached tipping point in 2011 when he learned of a dust storm in Germany which caused an 81 car pile-up on the autobahn, and this was after a huge 3m tonne soil plume that took off from Ukraine and dumped on Kent; and the reduction of farm wildlife; the increasing presence of pesticides in food products. His conclusion was that farming did, indeed, need to change if these problems were ever going to be addressed.

Politics, both national and international, have not helped. The UK refused to sign the EU Soil Directive, so preventing remedial changes being made across Europe. The UK's DFID continued to fund international agricultural research in the name of poverty alleviation which does not produce sustainable production solutions. DEFRA's "Soil Strategy for England" features a five furrow reversible

plough with digger bodies, and LEAF's document 'Simply Sustainable Soil Solution' for improving land sustainability displays on the cover page a picture of a plough at work. As an educator, Prof Kassam sees that agricultural students across the EU, and that includes Britain, graduate with a poor knowledge of soils and their protection and sustainable management.

Industrial agriculture with its reliance on genetics, agrochemicals in a tillage based system is one that has both fed the world and damaged the major factor of production - soil - over the past century, and has come to rely on inputs of mineral fertiliser which has resulted in the in situ loss of traditional germplasm resources.

Time off from teaching and research in 2004 gave Prof Kassam the opportunity to reflect on the wider aspects of the industry which he had spent his life, and to interpret and make sense of things that he had observed and questioned over the past five decades. He says:

My personal view and conclusion is: the root cause of our agricultural land degradation and decreasing productivity -- as seen in terms of loss of soil health -- is our low soil-carbon farming paradigm of intensive tillage which disrupts and debilitates many important soil-mediated ecosystem functions..." and goes on to say:

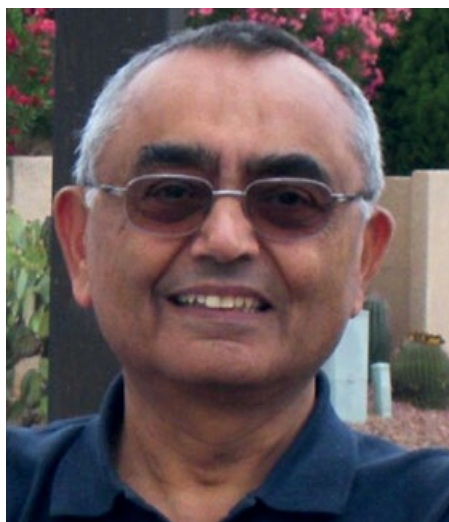
Further, I concluded that the condition of our soils was being exacerbated by: (a) applying excessive mineral fertilisers on

to farm land that has been losing its ability to respond to inputs due to degradation in soil health, and (b) reducing or doing away with crop diversity and rotations (which were largely in place around the time of WWII) due to agrochemical inputs and commodity-based market forces. Furthermore, I and others determined that the situation is leading to further problems of increased threats from insect pests, diseases and weeds against which farmers are forced to apply ever more pesticides and herbicides, and which further damage biodiversity and pollute the environment."

He notes that these ideas are not new. Edward Faulkner's *The Plowman's Folly* (published in Britain in 1943 as *Ploughman's*) is uncanny in its vision, so much so we have reproduced the chapter titled "Why Plough" on page 8.

Prof Kassam says that warnings of the degradation of soil have been almost continuous since the 1940s, and No-Till or Conservation Agriculture (CA) "is an effective solution to stopping agricultural land degradation...". The method has gained momentum in North and South America, in Australia and New Zealand, in Kazakhstan and China and in the southern African region. It has three core inter-linked principles:

- Minimising mechanical soil disturbance and seeding directly into untilled soil
- Enhancing and maintaining Carbon-rich organic matter on the soil surface using crops, cover crops or



Professor Amir Kassam of Reading University

crop residues

- Diversification of species - both annual and perennials - together or in rotation sequences. This can include trees, shrubs as well as crops and pasture.

The system is a lead example for sustainable crop production now adopted by the FAO in their publication 'Save and Grow'.

These fit in with the advice from the US National Soil Resources which is:

- Disturb the soil as little as possible
- Keep the surface covered throughout the year
- Have plants growing all the time

Opportunities for farmers, and mankind

Against the background of rising input, food and energy costs, CA can decrease fertilizer needs by 30-50%, water needs by 20-30%, fuel consumption by 50-70%, pesticide and herbicide use by 20%. Reduced cost of production with CA is a key to better profitability and competitiveness, as well as keeping food affordable. For example, using CA on Tony Reynolds' farm at Thurlby, Lincolnshire (UK), crop establishment cost comparisons show that costs are £245 and £36 for traditional method and for no-till seeding respectively. Similarly, his fuel use dropped from 96 litres/ha under the traditional tillage method for

land preparation and crop establishment to 42 litres/ha under the no-till method. Reynolds' experience of switching to CA confirms that the known advantages of CA include higher soil carbon levels and microorganism and meso fauna activity over time, minimisation or avoidance of soil erosion, the reversal of soil degradation, improved aquifer recharge due to greater density of soil biopores due to more earthworms and more extensive and deeper rooting. CA advantages also include adaptation to climate change due to increased infiltration and soil moisture storage and increased availability of soil moisture to crops, reduced runoff and flooding, and improved drought and heat tolerance by crops, and climate change mitigation through reduced emissions due to 50-70% lower fuel use, 20-50% lower fertilizer/pesticides, 50% reduction in machinery and use of smaller machines, C-sequestration of 0.05-0.2 t. ha⁻¹. y⁻¹ depending on the ecology and residue management, and no excess CO₂ release as a result of no burning of residues.

Advantages offered by CA to small or large farmers include better livelihood and income. For the small farmer under a manual system, CA offers ultimately 50% labour saving, less drudgery, stable yields, and improved food security. To the mechanised farmers CA offers lower fuel use and less machinery and maintenance costs. To the community and society, CA offers public goods that include: less pollution, lower cost for

water treatment, more-stable river flows with reduced flooding and maintenance, and cleaner air. At the landscape level, CA offers the advantages of better ecosystem services including: provision of food and clean water, regulation of climate and pests/diseases, supporting nutrient cycles, pollination, cultural recreation, conserving biodiversity, and erosion control. At the global level, the public goods are: improvements in groundwater resources, soil resources, biodiversity and climate change.

Prof Kassam concludes his talk on a positive note. The quiet no-till revolution which has been led by farmers across the world, in particular Brazil since 1971-72, has been spreading in all continents (but very slowly in UK and Europe), now accounts for 117m ha globally. The principles are better understood by the farmers who have adopted the system, and those advising them. He says that "Although agro-business money has captured government policy through controlling research and therefore our universities in the UK and mainland Europe, this can be turned into a win-win collaboration as has occurred in countries such as Brazil, Paraguay, Argentina, Canada, Australia/NZ and now happening in Kazakhstan, China and parts of Africa."

The changes he would like to see include all involved to work together to gain a better understanding of no-till from both a scientific and practical point of view. He would like to see more farmers themselves being a force for change and disseminators of knowledge, and believes that funding would provide real benefits for farmers and the countryside. Integrating the three basic components into the next CAP would be hugely beneficial, as would the expansion of university courses and agri education which incorporates CA. If DEFRA, DFID and other government departments were to employ staff with knowledge of CA, and if European donor and development agencies were to adopt and disseminate its principles in their strategies, the movement in Europe could start moving at the same speed as it has in other parts of the world.

Written by Mike Donovan of Practical Farm Ideas



This satellite image, taken on 16 February 2014, shows how soil is washed off our fields and out into the sea. ©NEODAAS/University of Dundee

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

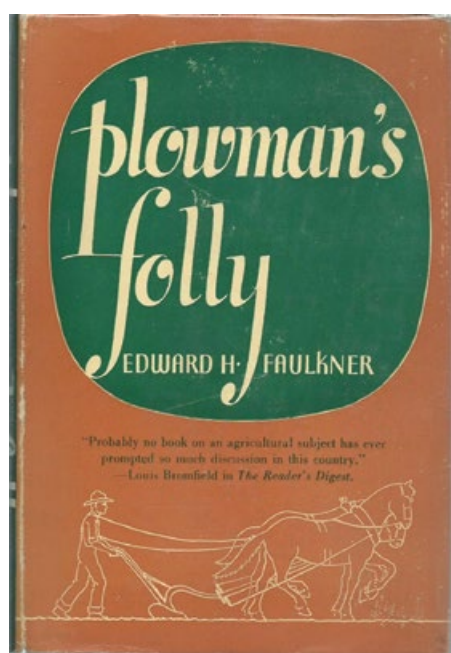
First published 1945

Traditions of the Plough

The answer to the question, Why do farmers plough? should not be difficult to arrive at. Ploughing is almost universal. Farmers like to plough. If they did not get pleasure from seeing the soil turn turtle, knowing the while that by ploughing they dispose of rubbish that would later interfere with planting and cultivation, less ploughing might be done. Yet farmers are encouraged to plough. Deep ploughing is approved; or, in lieu of deep ploughing, farmers are advised to cut deep into the subsoil in every furrow. Such advice comes from farm papers, bulletins, county agents, and a long list of other sources from which farmers commonly welcome suggestions and information. There should be clear-cut scientific reasons to justify a practice so unanimously approved and recommended. If there are such reasons I have failed to find them in more than twenty-five years of search. As early as 1912, when my classmates and I were taking courses in soil management and farm machinery, we brought up the subject, quizzing professors as to why ploughing, rather than a method of surface incorporation, should be the generally

accepted practice in breaking the soil. A number of answers were offered, none, however, of a scientific nature; in the end some embarrassed instructors had to admit they knew no really scientific reasons for ploughing. They suggested that the most important justifications for the practice might be that it "turned over a new leaf" for the farmer by the complete burial of preceding crop residues, thus leaving the land free from obstructions to future movements of planting and cultivating machinery. Our experience was not unique. The editor of one of the leading American farm papers has this to say in a letter written to me on August 5, 1937: "It is a subject I became interested in about eighteen years ago. I made a two-thousand-mile trip among soil specialists and farmers and everywhere asked the question: Why do you plough? I was rather amazed at the unsatisfactory answers I received. Apparently farmers do not really know. When I summed up the answers it seemed that they had only one good reason for ploughing, and that was to get rid of weeds." (Philip S. Rose, then editor of the *Country Gentleman*.) That there may be good reason to doubt whether the plough does even that is indicated in an article in the January, 1941, issue of this same publication, in which one writer points out that ploughing may preserve for future germination more weed seeds than it destroys. In all truth, the ultimate scientific reason for the use of the plough has yet to be advanced. My own position, however, has already been advanced in earlier pages of this book. If I were advising farmers on the subject of ploughing, my categorical statement would be Don't -- and for that position there is really scientific warrant. A brief review of the reasons frequently given for ploughing will give opportunity to point out the error involved in each. An administrative officer in the department of agriculture of one of the New England states suggests in a letter that ploughing is designed to allow oxygen to reach the roots of plants; he suggests, too, that ploughed soil will not dry out so rapidly

as unbroken soil. His reasons seem to cancel each other, indicating that he had not considered these two suggested effects simultaneously. Letting air into the soil is an efficient way of drying it out, particularly that portion which is disturbed. Since the roots of crops must develop first in this inverted (and necessarily dried) section of soil, it seems that my correspondent really gave a good reason for not ploughing. This idea -- that it is necessary to let oxygen into the soil -- has been in circulation for many years. It seems that those who pass it on do not pause to examine its implications. In a world organized as this one is, air is all pervading, except where something else fills the space. There is considerable space throughout all soils from the surface down to the level of ground water. Part of it is filled with capillary water, which clings to the rock fragments themselves; but since the spaces are too large for capillary water to fill them completely, air must fill the rest. When the water table rises, this air is forced out of the soil; when it recedes again, the air re-enters. (Water table is the name given to the level of water in any sponge-like saturated pervious rock below the surface of the ground. The level rises and falls in response to seasons of great or little rainfall. This ground water is the source of supply for perennial streams and springs. It is literally filtered water, since it has to pass through several feet of soil before reaching this low level. Streams supplied entirely from the water table are, therefore, clear at all times. Farm wells must be dug deeper than the lowest level to which the water table ever falls, or they become dry during long continued droughts.) It might be objected that more oxygen is required in the soil than can enter the undisturbed mass. Perhaps. In that case we should study the undisturbed forest floor. The surface of the soil where the giant sequoias grow was suitable for their needs a thousand years before the mouldboard plough was invented. It is not thinkable that such giants could have developed in the absence of an optimum amount



Plowman's Folly front cover

of oxygen in the soil. It must be, then, that growing plants do not require more oxygen in the soil than naturally enters it in the absence of water. There may be extreme situations, for example, where the soil has been excessively compacted by the trampling of animals or people, requiring special treatment. It is not clear, however, that ploughing would be the right treatment. The freezing and thawing of soil in winter usually assists a well tramped path to grow up in vegetation the following season, unless the use of the path is continued. Ordinarily the publications of the government and of the various state institutions can be quoted freely. The information they carry is designed for public use, and wide distribution is desirable. Ohio State University's Agricultural Extension Bulletin No. 80 is the only exception to this rule I have seen. It was copyrighted in 1928 and reprinted in June, 1940, still retaining the copyright. The reprinting of this bulletin justifies the assumption that its contents are still considered correct. Significantly, along with other government and state publications as well as the books on soils of the last decade or two, it takes for granted that the farmer knows why he ploughs. The letterpress then proceeds to describe "good" ploughing as the complete burial of all "trash" -- so complete that none is exposed even between the furrow slices. This, therefore, may be taken as the more or less official point of view. Various books on agricultural subjects published around 1910 do give what may be considered hypothetical reasons for ploughing. Most of them are vague enough to be interpreted in a number of ways. Here is a list:

- a) Soil structure is made either more open or more compact.
- b) Retention and movement of water are affected.
- c) Aeration is altered.
- d) Absorption and retention of heat are influenced.
- e) The growth of organisms is either promoted or retarded.
- f) The composition of the soil solution is affected.
- g) The penetration of plant roots is influenced.

This list was compiled from a single paragraph of a well-known soil text which was written in 1909. Though the authors did not realize it at the time, it is a bit of literary skating around a highly dangerous subject. The intent, apparently, was not so much to give information as to indicate in what various categories the student might expect to find it. The implied assumption is that ploughing improves the soil as environment for plant roots. The practice could scarcely be justified otherwise. Just how this improvement is accomplished is left wholly to the bewildered student's imagination. And while he is trying to rationalize this puzzle he is likely to conclude that, if ploughing really does improve the soil as a site for plants, the vegetation growing so lush on unploughed land must be to some extent underprivileged. Of course, even an astute student may miss that angle. It is obvious that most of us did. Assuming ploughed land to be better for plant growth, we should find grass growing more freely on ploughed land than on similar unploughed land near by. Weeds, too, should show preference for ploughed land. Volunteer growth should take over and develop more rankly after land has been ploughed than before. Is this so? Observation is that, until ploughed land has subsided again to its former state of firmness, plants develop in it quite tardily, if at all. When dry weather follows the ploughing, it may be weeks or even months before either natural vegetation or a planted crop will make normal growth. The fact is that "bare" land, which notably erodes worse than soil in any other condition, consists almost wholly of land that has been disturbed recently by plough or cultivating implement. The only other bare land is that which has been denuded of top soil by erosion or other forces. There is significance in the fact that erosion and runoff are worst on bare land, and that bare land is defined above. Take a casual glance at the landscape. Not only does the unploughed land continue to support its growth nicely while the ploughed land is recovering its ability to promote growth, but even the margins of the ploughed field itself continue to support their growth. Such evidence causes the argument that ploughing produces a better environment for plant roots to backfire. The loosening up, pulverizing, and inversion process seems a first-rate way to make good

soil incapable of performing its normal functions in plant growth. The explosive separation of the soil mass wrecks temporarily all capillary connections; the organic matter sandwiched in further extends the period of sterility of the soil because of dryness. Therefore, it is not strange that ploughed soil is bare. Before it is ploughed, grass, weeds, and other vegetation grow normally because there is unbroken capillary contact from particle to particle, extending from the water table to the surface. After ploughing, this source of water is completely cut off until the organic matter at the ploughsole has decayed. Hence the soil simply takes time out from its business of growing things until its normal water supply is restored. There is no mystery about it. It is only the working out of natural law. Wishful thinking is peculiarly ineffective in preventing this undesired outcome of ploughing. Another objectionable feature of ploughing is the merciless trowelling administered by the mouldboard to that portion of the furrow slice which is brought from the ploughsole and exposed to wind and sunshine. The effect is not noticeable, and probably not damaging, if the soil to the full depth of ploughing is dry enough to



crumble; but in these days, when all soils seem to become more troublesome to handle, it is seldom that spring ploughing can be done early enough, if the farmer waits for the wet spots to dry out to a sufficient depth. Too often in his haste to get the year's work started, he rushes into the ploughing while the soil glistens as it leaves the mouldboard. Some men even plough when water follows them in the furrow. Such management of the soil certainly is playing fast and loose with resources which the soil might contribute to crop growth.

To be continued in issue 2



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CONSERVATION AGRICULTURE GURU SHOWS SECRETS OF THEIR SUCCESS IN ZERO-TILL

No-till, zero-till and conservation agriculture have subtle differences in meaning. In all of them, seeds are sown directly into the stubble and trash (or rather mulch) left by the combine. Each of these terms is there to reflect the standpoint of the user. Zero-till says "I never use any cultivation", while No-Till is fractionally softer, so if a very light run over with a cultivator set at a few millimeters looks necessary, it will be done. The problem is that No-Till can then become 'light-till' which can then damage the natural soil structure which the system relies on, as well as reducing and removing the surface trash or mulch which is such a vital part of the system. Conservation agriculture has an even wider meaning. Cornell University has the best description: 'CA is a set of soil management practices that minimize the disruption of the soil's structure, composition and natural biodiversity.'

First published in Practical Farm Ideas Issue #95, Issue 24-3 Autumn 2015

Despite high variability in the types of crops grown and specific management regimes, all forms of conservation agriculture share three core principles. These include: A. maintenance of permanent or semi-permanent soil cover (using either a previous crop residue or specifically growing a cover crop for this purpose); B. minimum soil disturbance through tillage (just enough to get the seed into the ground); C. regular crop rotations to help combat the various biotic constraints. CA also uses or promotes where possible or needed various management practices listed below: 1. utilisation of green manures/cover crops (GMCC's) to produce the residue cover; 2. no burning of crop residues; 3. integrated disease and pest management; 4. controlled/limited human and mechanical traffic over agricultural soils.

Why the right terminology is necessary The UN Food & Agriculture Organisation (FAO) is even less definite: Conservation Agriculture (CA) is an approach to managing agro-ecosystems for improved and sustained productivity, increased profits and food security while preserving and enhancing the resource base and the environment. CA is characterised by three linked principles, namely: 1. Continuous minimum mechanical soil disturbance. 2. Permanent organic soil cover. 3. Diversification of crop species grown in sequences and/or associations.

Britain's farming ministry, DEFRA, has yet to connect with the phrase, favouring Sustainable Agriculture instead. If DEFRA is luke-warm, there's a growing army of UK farmers who are keen, committed and hugely knowledgeable, and some of these are happy to impart what they know. Regular readers of this Soil+ section in PFI will have read reports on some of these, and it is true that the knowledge of these farmers exceeds that of other experts.

Zero-till has given a decade of great farming

Tony Reynolds is one of the great UK 'daddies' of zero-till and conservation agriculture. Over the last five years I have listened to his contribution to various conferences, sometimes have managed to share a cuppa afterwards, and have always wanted to get to see and report on his farm. This season the stars lined up and I arrived at Thurlby Grange Farm near

Bourne, Lincs on an afternoon which had followed some heavy morning rain.

Arable farms run on zero-tillage are never impressive. The yards and buildings are largely empty of machinery - there's no big power around. The normal range of ploughs, cultivators, harrows, one-pass kit, tracks and large diesel tanks are just absent. So one searches in vain for signs of life, the wheels and machinery that provide the conventional energy to an arable farm. With zero-till, buildings are eerily vacant. The only machinery seems fairly modest in size, and it can give the initial impression that you've come to wrong farm, to a farm which does little or no work itself but leaves it all to contractors or FBT tenants.

"Wouldn't it be better to keep this top soil on your own farm"

It was October, and the land wet, and ditches three-quarters full of brown water, as was the norm when the ADAS advisor walked the land, and came out with the question: "Wouldn't it be better to keep this top soil on your own farm?"

The question struck a chord. The farm had been in the family for generations and one of Tony's primary goals is to leave it in good fettle for the next. Every farmer has relatively few farming seasons and Tony had seen a gradual deterioration in soil quality as well as erosion from water and wind. Losing soil was a poor way to go about providing a legacy, and he also reasoned it was a poor way to farm as well.



Tony Reynolds and grandson Sam who is studying at Moulton Coll and is fully engaged on the farm, cropping methods and soil biology

The question lodged in his mind, and while no big decisions were taken immediately the next spring he did no cultivations for some beans and spring barley, and for the next two years learned what he could about no-tilling.

"We tried a few different drills no-tilling 100 acres in one place and 200 somewhere else. Learning was not simple. Advisors in farming have always been risk averse, and colleges even more so. The farming internet was in its infancy, so contact with others more knowledgeable and interested in farming with zero-till was just not possible." Some direct drill salesmen had experience from overseas, but to a large extent Tony was on his own. But the ADAS advisor gave another useful piece of advice "either plough it or don't touch it."

In 2003, after two years of experimentation, they had a farm meeting to decide whether or not to commit the farm business to zero-till. Tony's son-in-law Clive was already a key figure in the business and he, together with daughter Terry and others were in full agreement to make the change.

The damage of top tillage

Tony is emphatic that merely reducing soil tillage rather than eliminating it does more harm than good. Soil pores are sealed by the the finer soil particles in the disturbed stratum and consequently water infiltration is reduced, root growth is restricted and yields suffer. Maintaining

stubble provides drainage structure, an environment for worms and other soil creatures which improve soil condition. Roots and stubble anchor soil.

When sowing into the previous crop's stubble, the RTK (Real Time Kinematic) global navigation satellite system now available on the farms means that the second crop (e.g. beans) can be sown precisely between the wheat stubble rows. The system can also be used to relay drill cover crops between the lines of the growing main crop.

OSR is broadcast directly, together with slug pellets if needed, by the Autocast which comprises a seed hopper attached behind the combine header; a fan and a manifold distribute seed to spreading plates and a land wheel meters the seed. The combine used on the farm has a Shelbourne Reynolds stripper header which leaves stubble standing in the field. This speeds up combining and leaves an ideal environment for the subsequent crop (and for trapping incoming wind-blown soil).

Crop establishment costs: Tony made a broad-brush estimate that CA crop production costs are around £30/ha compared with £266/ha for conventionally tilled crops. Some of this saving is due to lower fuel bills as diesel consumption, and the table shows the fuel use per ha since 2004-5, after zero-tilling had been introduced.

Crop yields: It is to be expected that soils damaged by conventional tillage

will need time to heal and re-establish their natural structure of aggregates, pores and channels; and this has been Tony's experience. Yields in year one after adopting CA were not noticeably lower, however years two to five may show a dip until pre-switch levels were re-achieved in year 6. From then on yields continued to rise before stabilising in year eight at a level higher than year zero. Tony continues to investigate why this yield dip in years 2 to 5 occurs on some soils but not others.

Earthworms are crucial to the soil rehabilitation process and their numbers quickly rise under a no-till and residue-retention regime (Figure 6). Tony has made some measurements and he found 47 earthworms in one sample of his no-till soil, whereas his neighbour, on the other side of the fence and with the same soil but ploughed each cropping season, had only one worm in the same volume of soil. The average worm count on the farm is between 80 and 90 under an area of 1m², the aim is to achieve 140-150/m².

Soil Carbon Levels: During the soil recuperation process, and beyond, soil carbon levels have continued to rise. The soil organic carbon (SOC) levels were measured by the Uni of Reading as:

2003 - 2.1% (low)

2007 - 4.6% (good)

2014 - 6.3% (v good)

SOC indicates soil fertility and so levels



Above: The quality of zero-till soil is easy to see, and smell. It provides field crops with a rooting compound that's more horticultural than agricultural

of P and K application have fallen by 80% each and N by 50% over the same period.

The effects on the two big arable problems

Blackgrass: one of the most difficult and costly problems of arable farms in the UK. Tony explained how a no- till regime can reduce its incidence. Eighty percent of blackgrass seeds die in the

Diesel Fuel Usage in Litres/ha

Sept 04 to Sept 05	96 litres/ha
Sept 05 to Sept 06	91 litres/ha
Sept 06 to Sept 07	49 litres/ha
Sept 07 to Sept 08	46 litres/ha
Sept 08 to Sept 09	42 litres/ha
Sept 09 to Sept 10	44 litres/ha
Sept 10 to Sept 11	43 litres/ha
Sept 11 to Sept 12	42 litres/ha
Sept 12 to Sept 13	43 litres/ha
Sept 13 to Sept 14	41 litres/ha

soil in year one and so, if there is no soil inversion, the mortality rate in year two will be eighty percent of the remaining twenty percent. No-till in conjunction with judicious application of Atlantis (iodosulfuro+mesosulfuron) at 0.4kg/ha has controlled blackgrass on the farm.

GPS mapping is used throughout the farms for soil fertility and crop yields. It is also useful for mapping patches of troublesome weeds so that they can be dealt with selectively, rather than over-dosing areas with no weed problems.

Slugs: Zero-till helps to control slugs in a number of ways. Slugs need a diet of rotting material and so seedlings growing in soil with low organic matter have no alternative feed for the slugs. In addition, worms like to eat slug eggs, so a high worm population helps, and the same is true for ground beetles, which



Wheat drilled on Sept 17 looks on the way to doing well

need a greater number of eggs. There's a balance created naturally, rather than a dependence on pelleting.

The benefits of good record keeping

Readers have to thank Tony for his consistent record keeping over the seasons which both preceded and followed the change to zero-till. The

numbers provide evidence like nothing else.

The experience which others had suggested that the conversion of the farm might take six years, and there was an obvious need to reduce the financial impact of this, and so they developed a six year plans for light, medium and heavy soils. In the first years of no cultivation the soil, low in organic matter and with few worms, bacteria and so on, will show poorer than normal fertility. So to counteract this they increased both seed and fertiliser rates to bridge the gap between soils being conditioned mechanically and then being conditioned with natural processes using surface mulch, worms etc. Fig 1. shows the changes they planned and enacted starting in 2003.

Seed Drills

With 2,000ha to drill on three separate farms there's a chance to have different drills working at the same time. This season the home farm with 500 acres had a new Weaving GD 4800T which works on 24m tramlines and is pulled with a Case 140hp, and a similar 6m drilled 860ha on another farm for 30m tramlines.

"The Weaving is the biggest advance in conservation agriculture for the past three generations." He says the sharply

Fig. 1. Reducing the Initial Impact of CA - Zero-till

Year of conversion	Soil type	Seed Rate	Fertiliser kg (check RB209)
1	As Standard for the farm	As Standard for the farm	
2	Light:	No Change	No Change
	Medium:	+5%	+8%
	Heavy:	+10%	+10%
3	Light:	+5%	+5%
	Medium:	+10%	+10%
	Heavy:	+15%	+12%
4	Light:	No Change	No Change
	Medium:	+5%	+8%
	Heavy:	+10%	+10%
5	Light:	No Change	No Change
	Medium:	No Change	No Change
	Heavy:	+5%	+8%
6	Back To Standard	Back To Standard	



The 4.8 metre Weaving GD 4800T is sowing at 6.5 inches. Tony would prefer 8in.

angled double disc opener works very effectively, and cuts through straw and surface material, causing less soil disturbance than he's seen with other drills. Less disturbance means fewer weed seeds being lifted to the surface so they germinate, and the surface mulch remains in place to speed soil biology. The double disc provides accurate seed placement and seed depth is easy to adjust.

But it is perhaps the way the slot is closed which is the neatest part of all. With the slot at an angle of 25 degrees the tyred press wheel closes it by pressing down on top. The wheel acts as a depth wheel and the angle of the main disc is such that there's a downward draught force. Discs can smear in wet ground, but whether this will be better than other discs such as the John Deere 750A or not is difficult to say.

Tony is really enthusiastic about the machine and farmers will find the sub £30k price for the 3 metre appealing, as they will the low cost of parts.

Autocasting Oil Seed Rape

Tony is a big fan of autocasting - featured first in Practical Farm Ideas in Vol 4 - 4 (winter 1995-6) and produced this cost

comparison table in fig 2.

Autocasting works well with well established zero-tilled land. The soil has a highly fertile surface, and the undisturbed soil is friable and good for the plant to root deeply. The seed gets put directly

has been done by Soyl and a comparison made over the years and the maps show a rising level of P and K, and none has been bought in for the past 8 years.

Earthworms clearly make a major difference to soil quality, and are essential if they are used as a cultivation tool.

Soil tillage methods and earthworms: Perhaps the most interesting is how close the reduced tillage land is to conventional ploughing and cultivating. Farmers might expect worms to be far more numerous if the soil is vertically tilled, yet the major difference is when no tillage is done at all. Worms create their systems of runs over years, can get to breeding. The worm has both male and female organs (hermaphrodites) and these are located in segments 9 to 15. When mating they get together with heads pointing in opposite directions and sperm is exchanged and stored in sacs. Eggs are laid around 27 days after mating, and populations can double in 60 days in worm farm conditions.

Fig. 2. OSR Establishment cost comparisons - £s per hectare

Process:	Conventional Cultivation	Zero-til	Auto-cast osr
Sub-soil	59	0	0
Plough	55	0	0
Disc	40	0	0
Spring Tine	23	0	0
Power Harrow	44	0	0
Drill	30	30	0
Roll	15	0	0
TOTAL	266	30	0

onto the soil surface and is covered with chaff and chopped straw. covered as the combine passes over and the seed is on the cleared strip between header and the seed covered with straw as the combine passes over

Soil Quality

Sampling for the main plant nutrients

Fig. 3 compares worm distribution in conventional, reduced tillage and zero tillage soils.

Originally written and pictures by Mike Donovan – and published in Practical Farm Ideas Magazine 24.3



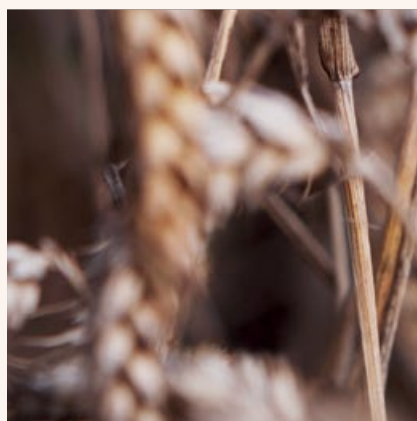
Fig. 3.

Tillage system	Population (worms/m2)	Biomass (g/m2)	Burrow volume (10cm3/m2)	Earthworm rejection (kg/m2/year)
Conventional	25	18	10	1.4
Reduced tillage	36	45	24	3.5
Zero-tillage	153	147	110	11

Source: F Terbrugge



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AQUA-TILL USES A WATER JET TO OPEN THE GROOVE

Originally written by Frédéric Thomas – and published in TCS Magazine in August 2013

Cutting with water Ultra High Pressure (UHP) technology is rapidly developing in the industrial world. We appreciate its ability to quickly and cleanly cut virtually anything. In agriculture, the need to precisely cut is just as much as requirement and in many different situations, with one such application being opening a furrow for direct seeding. Greg Butler, one of our Australian colleagues SANTFA (South Australian No-Till Farmers Association) who has had the ingenious idea of using UHP technology. Here are his reflections and the first results of its feasibility study.

The heart of this innovative approach, patented by SANTFA, is to replace the disk opener by a UHP waterjet. This could cut waste and even opening the floor without risk of including vegetation in the furrow. Open the furrow in this way requires much less pulling power and also wear on the components. The device could be provided by manufacturers as an option or available in kit form for mounting on older seeders.

Not Just Water But Also Fertilizer

Although the technology was developed with water, other liquid products such as nitrogen fertilizers may be used in the mixture. For phosphoric acid, which may precipitate under high pressure, tests are needed to determine whether it could be used as a cutting agent for the “liquid coulter.” Although the addition of fertilizer is not fully tested, this combination would reduce the requirement to transport liquid products and double the usefulness of the application with the bonus of a precise location of fertilizer. It appears, moreover, that injecting a fertilizer in this manner increases the dispersion into the surrounding soil furrow, thus reducing the risks of toxicity while increasing efficiency. This method could be particularly interesting for often sown rapeseed varieties in the presence of a large straw mat. Moreover, this little seed is very sensitive to crop residue in the groove and young plant appreciates a

bit of a boost in fertility. If chemical fertilizers can provide additional benefits, it is probably best to forget organic products, such as inoculants or other bacteria. They cannot survive the pressure in the pump, or the driving force to the nozzle outlet.

The First Feasibility Tests Are Encouraging

To better assess the feasibility of this innovative idea, a series of experiments were performed in March 2011 at Flow International's UHP Advanced Testing Facility in Jeffersonville, Indiana USA. The majority of tests were carried out at 15 km/hr; an execution speed is the maximum speed of sowing using disc systems. Depending on nozzles and pressures used, the volume of liquid needed however, is between 80 and 22 l / ha; which is an amount in line with the needs of fertilization and transportation options. At this point, the spacing between crop rows becomes an important factor by limiting not only the number of cutting nozzles but also by reducing



Captions

the volume of liquid required per hectare: standard gauge used in all calculations is 33 cm. The nozzle wear was also analyzed. Unfortunately, we are using the smallest holes, as they require the least amount of liquid, but that makes them the most susceptible to wear. Finally, the power demand can be quite important with the UHP, this was also evaluated knowing that the pump can easily be positioned directly over the tractor's PTO with returns of 90-92% on average against 70% a hydraulic drive. It would be relatively similar to that required for the tension opener discs and the operation of the pressure and volume of water required: between 3.5 hp and 11 hp per item depending on soil conditions and depth seedlings.

In terms of cutting waste, the tests yielded the expected results: the ultra high pressure jet cuts the same straws if they are wet or positioned on clay and greasy soil. The inclusion of "hair-pinning" residues as may be the case with the discs is therefore virtually non-existent with this principle.



Captions

In terms of Operation: if nozzles and average pressures are adjusted, penetration is enhanced with larger nozzles and higher pressures. However, this type of equipment and the volume of water required, approaches the limits of what can be seen in agriculture using a mobile tool.

A Great Idea With Many Agronomic Openings

After these initial laboratory tests confirmed the feasibility of this idea, if Aqua-Till is implemented on a drill, it can bring interesting agronomic benefits. Improvements to residue management from the surface of the



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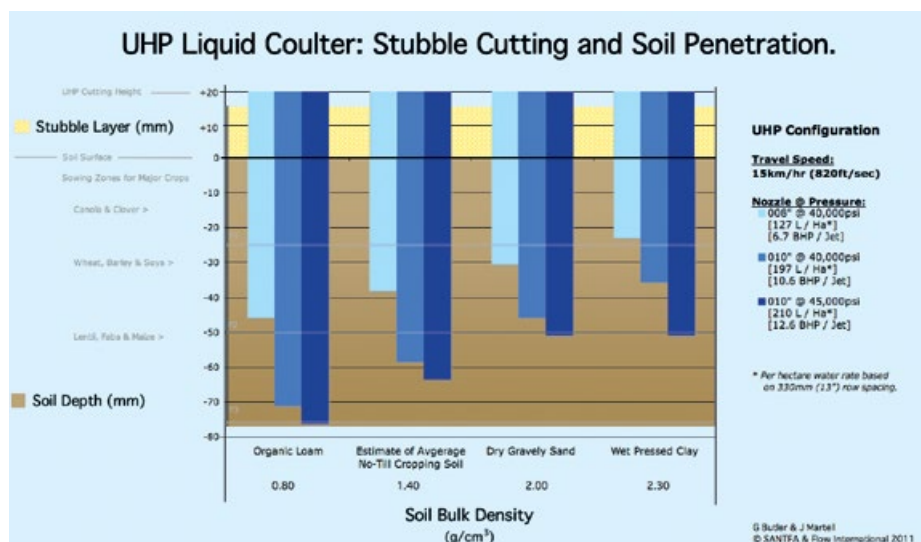
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groove (keeping trash out of the slot and away from the seed), the “coulters liquid” also may allow a significant extension of drilling windows in dry conditions where the power requirement and the wear are the limiting factors. Can when its wet, not having a mechanical element, eliminates chances of smearing, which could lead to anaerobic conditions for the germinating seed. In addition, even if the power required is similar, in proportional conditions and the same sowing depths, the “liquid coulters” requires no pulling power.

The size of the tractor can therefore be reduced due to the design and build of the drill. The Aqua-till concept is perhaps best suited to Seeder drills. Certainly it is seed drills using the Aqua-till concept that are most likely to emerge in the first place. However, Greg Butler went even further in his thoughts. Using a jet under UHP to cut waste, open the fold and place the starter fertilizer, he plans to position the seeds with an “air-gun” located just behind the jet and fertilizer. The only real contact with the ground would be a small press wheel to close the hole.



Ideally, the depth control would be determined by an electro-magnetic density sensor that adjusts the working equipment according to the ground variations. Finally, the “liquid coulters” may operate continuously or synchronized with the delivery of seeds. This option would significantly reduce the volume of water required but also the power to the pump level and is particularly well suited to a Seeder and would allow us to exit the compromised “disk” and move

towards seeding point by point with the additional benefit of the precise location of fertilizer: ideal for planting.

Although this idea, which is only a concept at the moment, may seem some way off, it is most definitely possible and tests are planned soon in South Australia. It also proves that technical advances such as this, as elsewhere in industry, allow us to take agricultural problems and create solutions that allow us to farm with greater ease and success.

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HOW TO START DRILLING FOR £8K

Clive Bailye's seed drill of choice is his 6m John Deere 750A, which has been used exclusively for 3-4 seasons. Last year, with an increased acreage, the founder and publisher of this Direct Driller magazine thought a second seed drill was necessary. Having just the one machine was a risk and in a difficult season would mean drilling was delayed. He looked around and found a good condition Horsch CO6 tine drill advertised in Germany.

Words and pictures by Mike Donovan

After delivery he rebuilt the coulters to a narrow profile so as to reduce soil disturbance. He says the tine drill is very useful drilling after straw crops such as osr and also through the straw on second crop cereals.

Buying the drill from a German farmer was not particularly complicated, and provided him with a higher spec machine than Horsch sell in the UK. The seed drill has much wider tyres, and the machine is fitted with blockage monitors as well as full width front packers and also a liquid fert application system.

A sheaf of photos were taken, and Clive then asked for some of specific parts to show wear. The deal was done at under £5,000 which Clive says is the market value of these machines which are too large for small farmers to buy. Original owners like to buy new and sell when the machine is still in good condition.

Narrow tines with wear tiles

Clive knew he wanted to make changes, substituting the Horsch tines and coulters for something far narrower, and has ended up getting his own design of

tine made, which has a wear tile made from Ferobide, far harder than tungsten.

The drill is on the farm primarily for osr and 2nd crop cereals drilled into chopped straw and the 25cm spacing is okay for these crops. Comments on Clive's on-line forum, TFF, said the drill many not be so good with beans, as the slot is a mere 12mm wide. And in barley the spacing may well be too wide as it needs to be thick. Clive points out that the seed pipe can actually be a bit wider than 12mm as it is in the shadow of the point. It would be good to have the option of using it for beans.



Above left: The cheap CO6 is being calibrated ready for its first outing



Above right: The adapted Horsch is being filled by the home built drill logistics trailer with seed and liquid starter fert.



Above left and right: The home designed coulter with Ferobide wear tile



Above left and right: Second wheat in March looks well, tramlines have not been made



Ball hitch is a continental standard and provides a positive connection between tractor and drill

Getting around the German instructions

The Horsch came, of course, with a control box and instructions in German. More on-line discussion revealed that English instructions were available on the Horsch website, and another explained that Horsch was sourcing some of these parts from Agton in Canada anyway. Zealman from New Zealand explained that the button marked with callipers should be held down for around 5 seconds. The menu is where you adjust

the tramline sequence, valve layout and row numbers.

A Stocks Wizard is on the back of the drill and used for Avadex. Here again the knowledge of actual farmers is helpful. Alistair Nelson warned that the rotor and the surrounding shroud need to be changed, and he got good advice "from Rick at Stocks". Clive has the same setup on the 750A and says that the Avadex leaks everywhere unless the modification is made.

The drill was acquired and modified in 2016 and the results have been excellent. The machine went through the residue without many problems and having the second drill has meant more timely planting. Clive has shown that moving into No-Till is not the expensive exercise so many farmers think it might be. The total cost, after modifications which included replacing all tines and coulters, was under £8,000.

Author Mike Donovan writes: we have featured a number of home made direct drills in Practical Farm Ideas, and are always interested in seeing more. Please contact me editor@farmideas.co.uk 07778877514

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The Stocks Wizard has a rotor modified for Avadex which otherwise leaks everywhere



ASDA SOIL MASTERS BURSARY VISIT US FARMS

Asda arranged and funded a 'Soil Masters' tour of a number of US farms which have been in the forefront of no-till techniques. The main part of the bursary project was to explore the feasibility of combining arable and beef farming using a combination of no till farming practices which include all year round crop coverage and natural fertilisation with the purpose of regenerating the ever decreasing organic soil structure and matter of over farmed soils thus reducing the need of chemical fertilisers, pesticides and herbicides to ensure our farming practices have a sustainable future.

Written by Mike Donovan

The Soil Masters group is a selected closed group of farmers and others with a specific interest in soil management. Steve Townsend of Soil First Farming said the trip was "mind blowing" for them all. Hearing how Joel Salatin had created seven inches of new soil on his land in just over 50 years (left to nature it takes 100 years to an an inch, while tillage farmers can lose nearly an inch a decade) by buying and getting hold of all sources of organic material to make carbon to build up what was a poor farm. Steve has not forgotten Joel's remark "most farmers try to make their farms bigger, I try to make my farm deeper".

The course was attended by 12 Asda arable no-till farmers, 7 Beeflink NSSSG farmers, was led by Pearce Hughes from Asda and occurred in 2015. Direct Driller is indebted to Mike Powley from York for the pictures.

Farm 1. Gabe & Paul Brown - Browns Ranch, Bismarck, North Dakota

The Brown ranch is located just east

of Bismarck, ND. Gabe and his wife purchased the ranch in 1991 and have expanded the operation to 5000 acres of owned and leased land. Son, Paul, returned to the ranch after graduation from North Dakota State University and became a partner in the operation. Daughter, Kelly, lives and works in Fargo, ND and returns home to help whenever possible.

The family believe in and practice Holistic Management, a part of which is farming and ranching in nature's image. They strive to solve problems in a natural and sustainable way. Improving soil health is a priority and no-till farming has been practiced since 1993. A diverse cropping strategy, which includes cover and companion crops are used.

They have now eliminated the use of synthetic fertilisers, fungicides and pesticides. They use minimal herbicides and is striving to eliminate them as well. This natural system of farming does not use GMOs or glyphosate.

The ever evolving grazing strategy allows most of their pastures a recovery period of over 360 days. These strategies have allowed the health of the soil, the mineral and water cycles to greatly improve. In other words, the natural resources have benefited. This results in increased production and profit and encourages the use of cattle production in precision arable farming. The Brown family believes their farming is a real way of moving towards sustainability for this and future generations, and increases the need for the use of cattle and mixed farming.

One of the main reasons for the Browns farming this way is to help improve the sales of his own boxed beef enterprise. He currently runs 350 late spring calving cows (all black) but with Hereford and British white genetics. The calves run with the cows for 11 months before being weaned. All the beef is grass fed with no cereal inclusion whatsoever and currently the animals are 26 months and 300kg deadweight at sale.

All cows are run as one mob and will run 10 bulls with the cows for a maximum of 42 days. The result is an average of just 8% of cows being empty, and 70% of his heifers were in calf after 30 days. Cows which are not in calf or which fail to raise a calf to 11 months were culled from herd.

The cost of animal to slaughter cattle is \$1086. The farm also includes sheep, chicken, pigs, and seed sales.

Farm 2. Jay Fuhrer – National Resource Conservation Service (NCRS) – Menoken Farm, North Dakota.

Jay has worked for the soil conservation arm of the USDA for over 30 years. In his first years he was dealing with land with a tendency to flood and his work was involved in planning and building irrigation ditches and dams. Today he sees this work as reacting to the issue rather than solving the problem.

In the last 15 years he has become the the world's leading resource on no till soil conservation agriculture. He now focuses on regenerative soil health typically bringing North Dakota soil from an organic matter of 2% to in-excess of 12% using holistic, pesticide free, fungicide free and herbicide free practices that promote soil regeneration. He achieves this by using increasing organic soil biology, soil armour made from crop residue left on the surface to create a water retentive soil structure and livestock fertilisation management.



The Soil Masters Bursary Group spent a morning carrying out practical hands on workshops that compared soil structure from the extreme of full tillage monoculture cropping with artificial nutrient and chemical usage to a natural biology fully diverse crop covering no tillage and livestock inclusion.

The workshops covered soil structure, organic content biology, chemistry and physical structure verses the effects wind water and heat.

The afternoon was spent exploring the trial soil fields of the facility understanding firstly the history of the Dakota's and its soil structure. Starting with the native American plains and their biological history following through to their demise and the wiping out of the buffalo herd and the effect of converting pasture land to cropping land. With this move away from extensive grazing came the destruction of the soil health due to mass cropping and artificial nutrients inclusion which from the 1970's.

Whilst mass cropping is still widely evident in the Dakotas, basically the soil is biologically dead and can now only be used with the use of artificial nutrients.

The government are now backing the conservationist's to regenerate the farming lands of the North Dakota's. The soil structure is being re-built with no till cover cropping and continual livestock grazing which is bringing back a soil that will continue to harvest

crops for the foreseeable future.

Farm 3. Joel Salatin – Polyface Farms, Harrisonburg, V.A

In 1961, William and Lucille Salatin moved their young family to Virginia's Shenandoah Valley, purchasing the most worn-out, eroded, abused farm in the area near Staunton. Using nature as a pattern, they and their children began the healing and innovation that now supports three generations.

Disregarding conventional wisdom, the Salatins planted trees, built huge compost piles, dug ponds, moved cows daily with portable electric fencing, and invented portable sheltering systems to produce all their animals on perennial prairie polycultures.

Today the farm arguably represents America's premier non-industrial food production oasis. Believing that the Creator's design is still the best pattern for the biological world, the Salatin family invites like-minded people to join in the farm's mission: to develop emotionally, economically, environmentally enhancing agricultural enterprises and facilitate their duplication throughout the world.

The Salatins continue to refine their models to push environmentally-friendly farming practices toward new levels of expertise.

Joel's farm is currently 650 acres of which 480 acres are woodland the remainder is used for open farming land for multi stacking farming practices.



He currently employs 20 staff with an annual turnover of 4 million dollars he prides himself on maximising financial return per acre by multi stacking production enterprises that are symbiotic to the farm.

Joel sells most of his products direct to the public on line with agreed collection points.

His main enterprises are salad bar beef, pasture fed chicken & rabbit, Acorn glen pork, pasture eggs, duck, vegetable growing, honey and timber products.

Joel's main focus area are grass and pasture utilisation.

Using the grass starts with the

cattle mob grazing the pasture with electric fenced paddocks. This is closely followed by the egg mobile, having laying hens in an old horse box. The free range layers like eating the residue cow pies left from the cattle and help spread the manure further afield benefiting pasture recovery and soil health. After the laying hens have been over the pasture, the boiler chickens follow with their portable shelters moving to fresh pasture daily.

The system moves cattle on a daily basis and Joel aims to achieve 400 cattle grazing days per acre per annum. The Virginia state average is 80 cattle grazing days, making Joel's system five times more than the average farmer in Virginia, yet at the same time he is

benefiting soil and pasture land.

Joel's cattle herd is 160 cows plus followers and he purchases 200 stirks a year. All of his production is slaughtered through his own abattoir and retailed through his on- line business.

During the winter a number of animals co habit in poly tunnels on a carbon based deep bedding system that will be utilised as compost on the rest of the farm after the winter period.

By focusing on carbon recycling and utilisation along with soil health Joel has managed to turn the farm from one of the poorest and least fertile into one of the most productive and regenerative farms in the USA. His



soil organic matter was 1% in the 1960's to in excess of 8% today as well as gaining over 10 inches of top soil.

Farm 4. McCormick Farm, Virginia Tech University, Harrisonburg, V.A.

The group had a late afternoon visit to McCormick farm owned by Virginia Tech University one of ten land based research units in the state.

We were hosted by David Friske who showed us round this beef and forage based research centre.

The unit was 1000 acres, holding 240 cow and calf pairs these are mostly Aberdeen Angus and Angus / Simmental cross.

All of the offspring are finished on farm going through feeding trials using Calan gate feed recording system. The university is currently focusing on mob grazing verses set stocking and forage

utilisation looking at improving farmer returns and efficiencies.

The party went to see one specific trial of strip grazing cows and calves with hot wire induced movements and creep feeding.

Due to the similarity in climate and production systems to the UK the group gained a lot from this it will be interesting to see the end results of this trial.

Farm 5. Mike Phillips United States Department of Agriculture (NRCS) - Valley View farm Harrisonburg V.A.

Mike farms with his wife on a 4th generation farm in Harrisonburg V.A. He currently runs 96 cow calf pairs that are a mixture of Angus and Angus cross and Hereford cross. All his cattle are sold to finishing feedlots at around 12 months old.

Mike has operated a closed herd for 26 years with the exception of buying in breeding bulls. All of the crops grown on Mike's farm are used

to feed the cattle operation. Mike has been using no till and cover crops for the last 15 years but the principles behind farm cropping dates back to his father's generation.

He has a unique and novel approach to cover crops and the varieties used, one field seen having 27 seed varieties growing at one time. He is a great believer of introducing cattle to new varieties of forage.

Part of Mike's land is loaned out to Virginia tech where agriculture PHD students are encouraged to trial rotational no till crop comparisons against conventional farming. The difference is measured by using basic biological physical and chemical markers for soil health.

Many thanks to Steve Townsend of Soil First Farming 01452 862696 and Mike Powley, Northern Farmer of the Year 2016 for their help in this report.

Written by Mike Donovan of
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START SIMPLE WITH COVER CROPS

Cover crops are becoming the new 'in' thing for arable farmers, and more are trying them out, often without really knowing what they are doing. Seed merchants are getting in on the act, and there's an increasing amount of conflicting advice out there. Farmers want a plan they can follow, and here is one for any practical farmer who wants to succeed with them.

Writes Mike Donovan in this article from Practical Farm Ideas issue 24-4

Steve Townsend has been into soil management and cover cropping since leaving the Eco-tilling team in Monsanto in 1997 to start Soil First Farming which advises farmers on soil issues using a hands-on approach. Steve is also into liquid crop nutrients and has developed a number of formulations which help farmers achieve improvements in their crops. During his time with Monsanto he became an expert in glyphosate. As farmers across the globe moved to minimum and zero tillage methods, Monsanto found their Roundup sales doubling every four years.

Working with soil became more than a job and Steve devoured all that he could on the topic, in particular the books and records kept by pre-chemicals farmers. Soil, and its degradation, has an immensely long history, which goes back to the Romans and Egyptians - "did you know that the main grain port of the pharaohs, used in 1400BC, is now 30 miles inland? Silt, the best part of the soil, makes up that delta, as it has been piled up over the millennia." The erosion and degradation continues today, with rivers in the UK and elsewhere carrying millions of tonnes of productive soil downstream

and into the seas each year.

Practical 'can-do' talk at the Real conference

This article is the result of Steve providing a scintillating 12 minute talk 'Managing Cover Crops' in the 2016 Oxford REAL Farm Conference. He has kindly shared his visuals with us. At the conference there was little time for pre-amble, but at our subsequent meeting there was time to set the scene. Soil enthusiasts are scattered across the globe. While the same broad message is common among all who understand how to protect, build and use soil advantageously, the detail from each is importantly different. To understand soils there's a need to understand these variations, and since starting his business in

1998 Steve has travelled extensively, learning the techniques of soil conscious farmers in many countries. It's experience he brings back home. So when we talk about docks in organic grassland, he suggests one looks at potash levels, in particular the phosphate P : K potash ratio. If there's too much K, as there often is in parts of the South West and South

Wales, the docks get out of control.

Soil carbon is the main factor for production in soil. Nutrients are less available when carbon declines. The decline in yield is inevitable. It can be held up by chemical intervention but this always needs to be increased in order to maintain yield. Carbon content is created from rotting organic matter, especially crop residues.

"Chopped straw is one of the best sources of soil carbon, and is far too valuable to be carted off to power stations. Left for worms, bacteria and fungi to break down, straw, together with the moisture we get, adds vital carbon to any soil."

The spider's web of soil

The structure and workings of any soil is as complex as a spider's web. The different components interlock to make it work, and the whole is fragile.

Ploughing and cultivating damage the web, but are sometimes necessary in order to provide a structure for it to grow. Ploughing in Roman times was no more than a two or three inch scratch on the surface - something which enabled a

seed to be covered over. Move forward a few centuries and the early mouldboard plough came along, and was a brilliant way to control weeds. These first ploughs worked to a depth of a few inches only. Horsepower was limited. With tractor power ploughs became wider, and therefore worked deeper, as the depth of the furrow is always around half the width. Digger bodies pulled up soil which had been sequestering carbon for hundreds of years. Exposed to sunlight and air the carbon deteriorated through oxidation, and when the power harrow came along the process was accelerated. Oxidation causes a major loss in soil carbon. With less carbon the soil is harder to work, so where once a light pass with the power harrow gave an onion bed, farmers were finding they had to do two passes to get an effective seedbed for corn.

Cover cropping seeds

Steve is emphatic on this - start simple. So you plan to grow a cover between harvest and a spring sown crop. That makes sense, as essentially farming is the art of capturing and using the sun's energy, through photosynthesis. Bare soil, be it cultivated or stubble, captures no solar energy, but growing plants do. They grow roots, harvest nutrients from air and soil, and provide a habitat for micro-organisms (as well as birds and insects).

So he suggests starting with mustard, or leaving volunteer oilseed rape to grow. Success builds confidence, and you want to reduce the risk of failure. You don't want to spend too much money, so start with inexpensive seed like mustard, so you can budget no more than £20/ha/year on the first three cover cropping seasons. The mustard, linseed, oats or barley produce good root mass.



Slug damage in turnips which were overseeded into wheat. The surviving turnips did well, but some parts were obliterated.



Low cost winter feed which builds soil condition as well

In years 3 - 6 go for high biomass plants, such as sunflowers, beans in addition to the mustard and so on. The budget could be £30/ha, but you are beginning to think there's some sense in the system. After year six you can add plants with higher bio-diversity, but also higher seed prices. Vetches and clovers will add N but work better in soils which are inherently fertile.

There's a big difference between species and variety of cover crop seeds. Go into a field of phacelia (which is not supposed to be frost hardy) during the winter and you'll find some plants have been killed by the frost and others are doing fine. The seed was bought as 'phacelia', the species, so the bag contained a number of different varieties. We don't buy cereals as 'winter wheat' but as 'Claire', so we need to know what variety we are buying.

When to get the seed drill out

There's a simple answer - as soon as possible. You need to organise the

cover crop drilling to be done while the combine harvester is in full swing. The soil will still have moisture in it, enough to get your mustard off to a good start. Steve says "don't think of overseeding to start with, as the risks are far greater than drilling. Remember, you want a crop." As soil fertility improves, so broadcasting becomes a more reliable way to put these seeds on.

Spinning them out with a fertiliser spreader has problems. Mustard goes on at 10kg/ac and stubble turnips 3-7kg. Seed doesn't travel the same way as fertiliser, and will find any narrow gap to escape being broadcast at all. Mixing with fertiliser makes the spreading rate easier, but the seed separates in the hopper. E_B from Norfolk explained on TheFarmingForum how he spins turnip seed on 2 - 3 weeks before harvest using a spreader that goes no further than 16m. His tramlines are 24m apart. As soon as the bales are off he fills in the gaps with the spinner. If it's dry he drills the gaps with his Kverneland Evo tine drill, just scratching the surface.

Broadcast seeds grow very much better in fertile top soil which has been worked over by worms and other critters. Your first season top soil could be badly degraded. When those plants are small, look after them like any other crop. If there slug challenge, get some pellets out, and if they look poor, perk them with 15-30 kg/ha of N. Your aim is to have a good crop just the same as cash crop. The investment will pay off, because the next year it will grow better.



Cover crop destruction

Autumn sown covers that are to be terminated in the spring ideally should be sprayed with glyphosate the day of drilling. Moisture translocation stops 24 hours after spraying so it's important rain doesn't fall between spraying and drilling as the cover crop could become the perfect mulch stopping the soil from drying out.

Maybe there's a lot of grass weeds, and black grass. In which case spraying needs to happen early, by the end of January, to effect good control of these weeds.

A clean crop which is free of blackgrass might be grazed off, but not too hard, so the soil remains covered.

Organic farmers and those who disapprove of glyphosate can consider the Rodale crimper roller which flattens and bruises the stems of most plants sufficiently to kill them off, though results have been few and mixed with this technique..

How about grass and soil condition?

Once again, Steve says "look at the soil" and try to copy what happened in the world's natural grasslands. Bison herds were constantly moving, eating the tops of grasses and moving on. Yet we like to graze the sward to an inch or two. We're told to never let grass go to head - yet when cattle break into a hay field they dive at the seed heads. Grazing tightly causes swards to become open, need reseedling, as this grazing weakens the preferred species allowing less productive grasses to creep in.



Sheep on oversown stubble turnips

He's seen mob grazing in the USA and understands the theory and results behind it. Grass and herbage build up biomass in an 'S' growth curve, which means a lot happens, or could happen, just after the conventional farmer grazes the sward off. Get the grazing controlled so the that spurt of growth, which includes the creation of the seedhead happens, and the quantity of material produced is far greater than when grazed conventionally. The sward must then be allowed to recover - the bison have moved on!

Back fencing is the most productive action in a strip grazing system. It takes little time to shift the fence. The back fence stops the stock from returning and snipping off the new shoots, which causes the plant roots to weaken. Those new shoots are fed by goodness from the roots. When the grass is short, the roots are also short. As it gets longer and more mature, so energy is put into the rooting

system so they grow bigger, allowing the grass to recover quicker from the energy in the bigger root mass. The best grasses are quickly damaged in swards which have no rest from grazing as the roots never have the time to recover. Weeds take over.

Steve refers to Prof William Albrecht who spent many years studying the best soils and who wrote many illuminating works on soil balancing. Andre Voison is another luminary, particularly in grass, rotational grazing and grass production.

Soil is exciting material which farmers have almost been encouraged to neglect for too long.

Originally written and pictures by Mike Donovan – and published in Practical Farm Ideas Magazine 24.4

**PRACTICAL
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Close-up of the grazed field showing a worm midden where they collect straw prior to dragging it down using holes they have made.



Grazed lightly, the sheep are moved on before they damage to soil. Waste makes essential biomass.



COULD YOU RUN A FARM SCALE TRIAL IN 2018?

We as farmers are constantly being told about trial results, but as they say, there is nothing like trying things yourself on your own farm. Many of you out there are indeed already doing this, but what we would like to see is people sharing these results so other farmers can use that information on their farm. One example of this was Clive Bailie's trial of Adexar® and Librax® verses both his on farm standard and Aviator® Xpro. This was reported, live, as part of a thread on The Farming Forum, so other farmers could see what decisions he was making at any time and talk about exactly how his trial was taking shape. This included the prices various products were purchased for to properly analyse what the profit was from each different trial plot.

Clive will say that he was sceptical of BASF's claim of an extra £20 a hectare margin using their products, but his own trial showed exactly this. For Clive, on his farm in Staffordshire in drought prone soils, T1 Adexar® and T2 Librax® gave an extra 0.43 t/ha and £57/ha margin over Aviator® Xpro. It also returned a greater margin than his farm standard as well. However, behind the scene's BASF also asked a number of other farmers to run the trial as well. These weren't reported live, like Clive did, but the results all help farmers build a picture.

3 other Farmers, Nigel Durdy, Russ McKenzie and Conor Colgan also ran field scale trials in 2016. In 2017, BASF widened the challenge to 50 farms. Bayer also ran their own programme of farmer led field trials 2017 called

All of the BASF results can be found in more detail at www.basfrealresults.co.uk and all of the Bayer Results can also be read about on The Farming Forum. While one set of results often doesn't help a farmer reading them, putting these results together, gives farmers a lot of different soil types and farm practices to compare against their own to try and deduce whether they would see the same sort of gains. And that's the real goal here, to give farmers as much information as possible to make on farm decisions.

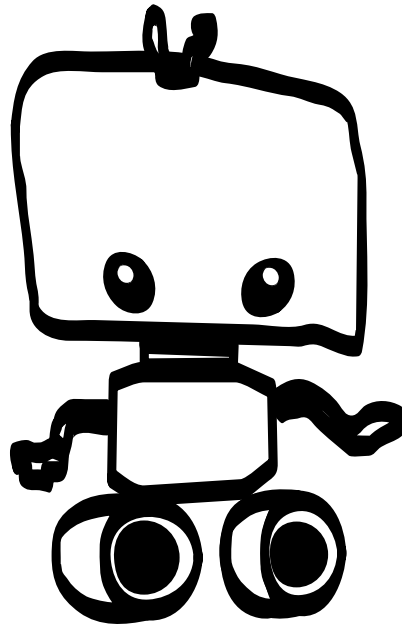
ADAS's Daniel Kindred has been helping to put together different farmers research under the umbrella of Agronomics

So we would like to see more on farm trials, with farmers reporting them live on Twitter, their own websites or The

Farming Forum. Where farmers set out an aim or a "challenge" and then report on it through the year. It doesn't have to be fungicides, it could be comparing two drills, the fuel economy of two tractors, the work rate of two combines, different drilling dates, really whatever trials you think would benefit "your" on farm decisions. These trials can then be shared with other farmers and we all get more information to make our decisions on.

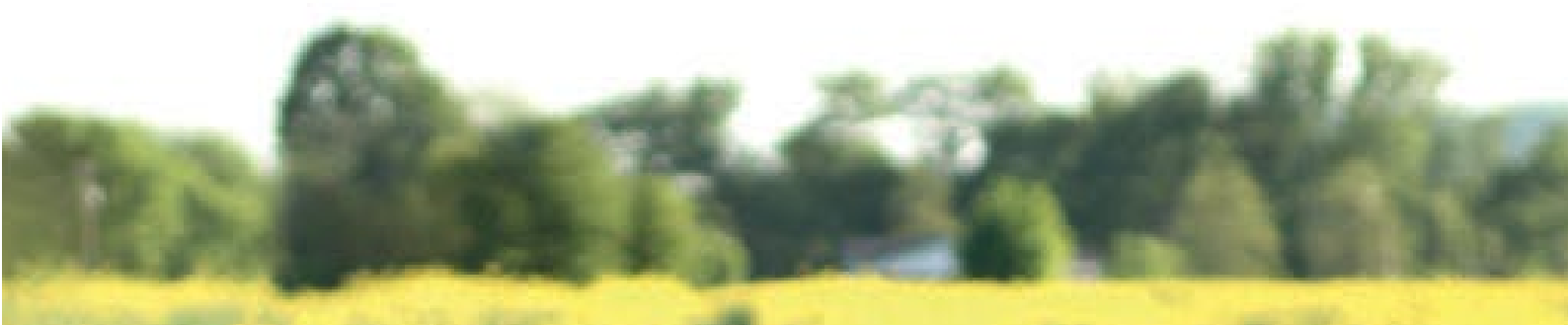
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ALEX SHUTES



I'm Alex Shutes, 28 years old, a graduate from Harper Adams University in 2012 and now a farm manager on a 200ha all arable farm in Essex.

We grow Oilseed Rape, Wheat, W Barley, S Barley and S Beans on a 7 year rotation but with the mindset of not being afraid to chop and change depending on crop prices, the weather or for any other reason that requires a change in plans.

Our 1st wheats are grown as a low pesticide biscuit wheat destined for Heinz to produce baby food products, our 2nd wheat's are feed, both our winter and spring barleys were grown for malting although this coming 16/17 season we have switched our winter barley to Volume hybrid barley grown for feed. Our spring beans are grown aiming for human consumption spec. The rotation has been lengthened from a predominantly Wheat - Wheat - OSR rotation on some of the farm with some barley here and there to this longer 7 year rotation to try and get a range of crops of different plant species growing successfully across the whole farm acreage each year to help both with soil and crop health and as part of a weed control strategy.

On this farm our soils vary considerably from light sandy loams, very gravelly sandy clay loams, clay loams through to heavy Essex clays.

Our previous establishment system was to plough and furrow press, power-harrow (sometimes twice), tine drill and then roll. It was quite labour intensive and used a considerable amount of fuel and wearing metal. However it was a fairly reliable system that could continue to work (to a point) in wet years and across all of our soil types we have here. However circumstances on the farm meant we had to look to get the farm into a system where 1 man can do the majority of the establishment work as well as crop spraying and fertiliser applications as opposed to the 2 man system as described above. This while also trying to reduce establishment costs at a time when crop prices are at the lower end of the scale but with a longer term view of improving the soil health across the farm

and continuing to maintain or hopefully improve yields.

I have been interested in one pass strip tillage type systems, that begun to emerge in the UK from the likes of Claydon and Mzuri and laterly Sumo amongst others, since I was at university. I could see the benefits it could bring to an arable or a mixed farm both from a cost saving point of view and the potential to be part of an overall system to help improve soils on a farm over time. I didn't feel that our farm and soils were ready for a full no-till system and I felt that a min-till system wouldn't help improve our soils or reduce our establishment costs enough to make it worthwhile so I felt strip-till was the best route for our farm at the time.

So in a move to a new and completely different establishment system for us we bought a 3m Sumo DTS drill in the summer of 2015. The initial purchase price of the drill was a big cost for us but we needed a new drill anyway as our old Weaving tine drill was starting to show its age a bit. Whether we had bought a tine drill again, a combi drill, a cultivator type drill such as a Rapid or a full no-till drill, most would have cost us £25k-£40k so price wasn't as big a factor as getting the right drill for what we wanted to do. The DTS capability to drill into any type of seedbed was very useful for us as we are required to plough previous crop residues before planting our low pesticide 1st wheats. All other crops are sown directly into stubble or an overwintered cover crop. Sumo's reputation as a British manufacturer making well built, high quality machinery was also another factor for us.

In the first summer with the drill we drilled all our OSR plus some cover crops on land that was going into spring cropping in the spring of 2016. We found quite quickly that the DTS wasn't all too keen on the large amounts of straw that were being seen after harvest 2015 especially when drilling shortly after the combine had been through the field as it

didn't take much for the drill to block up. The issue was improved by cutting our stubbles shorter and by the time we came to autumn drilling the stubbles had all become brittle and were no longer really a problem. Sumo didn't ignore the problems we were having though and provided us with great backup from the initial setup of the drill when we bought it, to various modifications that have improved the performance of the drill remarkably in trashy conditions so much so that now into Autumn 2016 drilling the drill hasn't blocked once since!

When purchasing the drill we didn't buy a straw rake at the same time as we thought we would see how we would get on for a year without one. The majority of the time we didn't have too much of an issue but I have since found that trash flow through the drill is better when using it on raked stubbles. The main reason for buying a straw rake for us is that our current combine doesn't have a chaff spreader so unfortunately we found that thick rows of chaff and short straw every 18ft in fields direct drilled into stubble have caused issues with greater amount of N lock-up, a greater number of slugs and very wet soil underneath the chaff that smeared whereas other parts of the field with no chaff on had a nice tilth, therefore we ended up with thinner crop on those thin strips where the combine had been

So we have now bought a 6m Weaving stubble rake with the view that it should spread straw and chaff about more evenly to solve the above problem, kill a few slugs and destroy some slug eggs, germinate weeds and volunteers, start the breaking down process of previous crop residue and let air into the top of the soil.

I haven't seen any instantly visible changes in our soil health but have seen a few examples that we are heading in the right direction. A good example would be in some of our heavy land fields, that often would plough up in slabs and take



LEFT: Drilling setup (Claas Arion 630 and Sumo DTS3) RIGHT: Spring beans into mixed species cover crop



a lot of power-harrowing to break into a cloddy seedbed in a dry year or would be a smeary mess in a wet year, were drilled in 1 pass into a nice tilth in the top 2 inches saving considerable amounts of time and money. I have also found that fields that have been direct drilled allow us to get back on the land much sooner when spraying or fertilising than we can with our ploughed fields which can be very beneficial when spray days can often be at a premium!

I have seen a saving of roughly £60/ha in establishment costs compared to our previous method of establishment, more accurate figures will be obtainable when we have to change more metal on the DTS than just the ripper leg. Fuel usage is between 11-12l/ha over the majority of our fields which is half what we use just by ploughing alone.

Having done considerable research into cover cropping we have begun using cover crop mixes before spring beans and spring barley in our rotation. This year I'm using a legume free mix before spring beans and a grass species free mix before spring barley. I am still very much experimenting, getting cover cropping and spring drilling right on heavy land is not easy at all but you don't learn anything

if you don't try things on your own farm. Direct drilling in the spring is also very different to our previous system, I have found a lot more patience is required in difficult springs such as this spring just gone. I have used our stubble rake before this summer's cover crops were drilled and will use it again this coming spring when the cover crop has been killed off in the winter to get air and sun into the top of the soil, spread residues about and kill any slugs that I can.

Results from harvest 2016 were quite promising overall for our first year in the system with just slightly less yield in most of our crops compared to the exceptional harvest last year. We had 1st wheats established with both our drills into ploughed land and there was no real difference in yield, quality or blackgrass levels between the two. We also had some 2nd wheat land ploughed as a comparison between that and direct drilled land and again very little difference in yields between the 2 systems. Our OSR and W Barley yields weren't great but were very similar to other farms in the local area so the different establishment method wasn't the cause of any yield drops it was just the weather across the growing season. Our S Beans yielded

better than previous years crop planted into ploughed land but this being only the 2nd year of growing them we need a few more years yet to start getting some average yield data. Our S Barley was the biggest disappointment and where I feel we have the most to learn about this new system. Heavy land in a wet spring plus high slug pressure made it clear that direct drilling in the spring is very different to direct drilling in the autumn.

In the future I would like to look at introducing some more organic matter to our soils in the form of compost, manure or biosolids whilst still chopping all our straw and using cover crops as I feel this will drive our soil health on at a greater rate than cover cropping alone. I will also continue to try different crops and varieties to see what can work for us on this farm. As mentioned above we have moved to hybrid winter barley and we are also trying some Belepi wheat to see what effect these can have as part of a blackgrass control strategy. I am also trying to think what we could grow instead of OSR in the coming years if CSFB, slug and pigeon pressures get even worse! Ideas so far include Soya and Sunflowers so there could be some interesting times ahead!



LEFT: Drilling 2nd wheat 6/10/16 RIGHT: Middle pic - Wheat seed in tilled strip approx 35mm deep



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GETTING POSITIVE RESULTS FROM A COVER CROP 'ADDICTION'

Originally Printed in No-Till USA By Julia Debes

Bill Buessing leaves no stone unturned as he seeds various cover-crop species to feed cattle, build up soils and fix nutrients for cash crops.

Pictured Above: FULL COVERAGE. A self-described "cover crops addict," Bill Buessing maintains a cash crop or cover-crop mix on every acre of his farm year-round. Not only does this protect and improve the soil, it also provides forage for his cattle and has allowed the Axtell, Kan., no-tiller to cut back on fertilizer.

While growers across the U.S. are experimenting with integrating cover crops into their rotations as a source of livestock forage, few do it with as much flair as Bill Buessing.

A self-described "cover crops addict," the Axtell, Kan., no-tiller maintains a cash crop or cover-crop mix on every acre of his farm year-round. Buessing also seeds an experimental plot each year, testing more than 40 different types of cover crops and blends. He puts the results to work for both his traditional cash crops and a growing cattle herd.

He says covers let him reduce nutrient runoff, retain and utilize more water, slow down wind erosion, help with weed control, build organic matter in the soil, recycle nutrients, feed cattle and build nitrogen (N) for present and future crops.

But, he adds, achieving maximum results requires more than simply adding another planting to a farmer's rotation. No-tillers must learn how to manage crops more intensely, as well as document how variations in cover-crop blends and practices affect yield and soil health long-term.

"You have to change your mindset if you're going to make cover crops work," he says. "Implementing cover crops is a process that does not always show immediate rewards."

Cereal Rye Workhorse

Utilizing a secondary crop for livestock feed is not new to Buessing's family operation. His father drilled oats into wheat stubble for fall pasture, and when Buessing purchased his first farm in 1998 he did the same where soybeans weren't double-cropped behind wheat.

But with two brothers also farming, Buessing says his father — who is still active in the operation himself — encouraged all three of them to branch out from his farming model.

"Dad encouraged us to think for ourselves and make our own decisions when we started farming," Buessing says.

For Buessing, the integration of cover crops was more than an experiment — it was a necessity. For 19 years, he worked as a lineman for the Nemaha Marshall Electric Cooperative by day and tended to his farm and cattle after hours. But as his oldest daughter approached high school, his wife Sandy challenged him to find a new way to both farm and spend more time with family.

With 440 acres, a smaller-than-average farm size in Marshall County, Buessing weighed how to increase profitability enough to justify leaving a full-time, off-farm job. The answer: Planting cover crops as forage.

"I don't farm enough acres to farm full-time without cover crops or livestock," he says.

Buessing began seeding covers for winter forage in 2003. In 2007, he seeded cereal rye specifically as a cover crop, after corn and ahead of soybeans. He uses a Landoll

drill to seed his cover crops.

"Cereal rye does a lot for your soil," he says. "It's the closest thing to a silver bullet



Solar crop panels. Bill Buessing says the wide leaves catch more sunlight and build carbon that can be utilized by subsequent corn or soybean crops. The large canopy also helps suppress weed growth.

that we have found."

He explains that cereal rye, which he typically seeded around 50-60 pounds per acre, has the biggest root system of any winter cereal, so its roots can help break up hardpans in the soil. In addition, the root system uses extra N from the previous crop and stores excess N for future crops, while adding carbon to the soil and building organic matter as well.

On top of the soil, the cereal rye helps suppress weeds, Buessing says, requiring fewer chemical applications to keep the field clean, reducing wind and water erosion and holding more water to preserve rainfall moisture for the growing crop in the summer. Finally, cereal rye helps keep the soil cooler in the summer, which benefits both the soil biology overall and the subsequent soybean crop, he says.

Buessing now utilizes up to 40 different cover crops in his blends. Individual blends may contain up to 18 different covers, depending on whether they're used strictly as forage or in rotation with cash crops.

Boosting Cash Crops

Maintaining a cash crop or cover crop on every acre all year since 2013, has helped Buessing correct a problem he spotted in an aerial photograph of his farm taken during the winter months of 2011.

Looking at the picture, Buessing realized that residue-covered fields surrounding his home, with nothing growing on them, meant lost opportunity to capture the sun's energy to fuel the next year's cash crops.



Year-round grazing. Bill Buessing's forage mix is spread out so he has forage available for his cattle all year. Cattle are moved to cool-season pastures after leaving the winter cover in spring, then to a summer blend planted in May.

"From September to April, there was nothing growing," he says. "That is 8 months of carbon-capturing potential wasted."

By planting a cover-crop mix in addition to his cash crops, Buessing feels he's putting soil biology to work 12 months a year. For example, he explains that planting brassicas is like installing solar panels: The wide leaves of the plant catch more sunlight and build carbon that can be utilized by subsequent corn or soybean crops.

As a bonus, the large canopy also helps to suppress weed growth.

The addition of covers also provides protection from wind erosion and nutrient runoff. For example, Buessing recounts receiving 3½ inches of rain in July during one weather system, and when he sprayed a field of soybeans planted into cereal rye the next day, he left virtually no tracks in the soil.

Today, Buessing reports his crop acreage now includes 20% corn, 20% soybeans, 20% winter cereals (primarily cereal rye), 25% spring and summer crops for grazing, 5% perennial cover crops and 10% expired Conservation Reserve Program (CRP) ground that will also be grazed and later planted to cover crops.

For his cash crops of corn and soybeans, Buessing views the preceding cover crops as free labor to improve yields.

"If you feed the soil, the biology works for you," he says.

For example, he reports that planting cereal rye ahead of soybeans has increased yields by an average 3-4 bushels an acre since 2007, compared to using no-till alone,

with the advantage as high as 10 bushels in some instances.

Buessing typically plants cereal rye in the fall after corn and terminates the cover with 1 quart of glyphosate just before or just after planting soybeans. Termination timing is important, he notes: If cereal rye is terminated before he plants soybeans and the soil gets wet under the residue, he says he can have big problems with establishment. Instead, Buessing prefers to plant soybeans into the living cereal rye and terminate the cover crop the same day.

For corn, Buessing applies liquid N in the spring with a rolling cutter and sidedresses later. But with cover crops in his rotation, he uses less fertilizer than his neighbors. The exact amounts depend on previous applications, the level of organic matter on the field and the composition of previous cover crops, but the average rate is about 6 gallons of liquid N per acre.

"I use less fertilizer than my neighbors and I am building my soils," Buessing says.

Buessing further captures market potential by planting non-GMO corn and soybeans. He says doing so allows him to meet local needs, purchase less expensive seed and achieve similar yields. Furthermore, he reports receiving premiums of \$0.30-\$0.50 per bushel for non-GMO crops.

Maxing Out Profits

Buessing increases the profitability of his cover crops through his growing cattle herd as well. He currently runs 40 cow-calf pairs with some replacement heifers, in addition to grass-finishing an average 40-50 head and 100 stockers to sell into local markets.

"Livestock grazing cover crops help provide a quicker return on your investment," Buessing says.

For example, Buessing ran 24 pairs for 100 days and 10 bred heifers on a winter grazing blend for 145 days on 60 acres one winter, with no additional supplements. He reports that in another field, 78 head of cattle weighing 400-800 pounds a piece, grazed 30 acres of cover crops over 25½ days and gained 2.78 pounds a head per day. Each acre produced 180 pounds of beef.

Both of these fields followed a winter cereal crop and were planted in late July or early August.

Buessing spreads out his forage mix so that he has some forage available for year-round grazing for his cattle. After leaving the winter cover in spring, cattle move to cool-season pastures, then go to a summer blend of cover crops planted in May, he says.

Next, they go to warm-season pastures before going to an August-planted cover-crop blend. After that is a post-harvest blend grazed through winter until spring.

Reducing Feed Costs

Buessing's fall cover-crop blend costs \$45.72 per acre. The mix consists of 18 different cover crops, including primarily spring oats, cowpeas and spring peas, with smaller amounts of sunn hemp, Bruits hybrid forage sorghum, Mancan buckwheat, hybrid pearl millet and sunflowers in addition to even lesser amounts of the remaining crops in the mix.

This diverse mix and extended grazing period allows Buessing to save time and money in winter months by reducing the need for purchasing winter feed. When he does supplement forage, about once a week in the coldest months, he rolls out his round bales rather than feeding in a feeder, typically in a new location each day.

This allows Buessing to more evenly distribute both soil compaction and manure, as well as add N to trouble spots in fields without having to apply N in the cash crop growing season.

On one field that received significant snowfall, and where the cover-crop mix never froze, his cattle went 40 days without additional water. Far from stressed, the cattle had maintained their hydration by digging through the snow to reach the still green cover crops below.

In the spring and summer, Buessing rotates his cattle through paddocks, using a plastic-coated electric fence typically used for horses that can be easily moved using an ATV. Buessing limits this grazing area to roughly a 100-foot strip at a time.

"You get better utilization if you make the grazing area smaller," he says.

Buessing aims to rotate cattle between paddocks every day during warmer months, but may leave cattle for up to 1 week in a larger location during the busiest months of the farm season.

Buessing's summer cover-crop blend costs \$71.30 an acre, and the mix consists of grazing corn, cowpeas, sunn hemp, hybrid sorghum-sudangrass, mung beans, Mancan buckwheat, sunflowers, mustard and hybrid forage collards.

Buessing also plots out his cover-crop seeding near cash crop stubble in later months. By locating a cover-crop mix next to stalks, Buessing reduces the need for supplementing by simply managing the flow of cattle between the two fields.

Grazing a cover crop requires a different mentality than grazing a forage crop, Buessing notes.

"Grazing a forage crop, in my opinion, means grazing a crop until there is almost nothing left to eat, while monitoring animal performance," he says. "Grazing a cover crop means grazing the vegetation and leaving a good percentage of the cover left."

This includes both cover crop laying on the ground and left standing, he adds.

As a result, Buessing says he grazes only about 35% of any given cover crop, going so far as to even include crops in his mix that cattle won't eat. While this practice can reduce harvest efficiency by 30-40%, the limitation allows him to maintain good nutrition for his cattle and preserve soil protection.

"You have to leave the soil covered and feed the soil biology if you want the soil biology to work for you," he says.

Boost with Blends

Buessing notes that not all benefits of using cover crops are as immediately visible as fat, healthy cattle grazing. As a result, he monitors success with covers through observing the amount of weed suppression, as well as by comparing yields to check strips in fields and conducting soil sampling.

To start assessing the payback for covers, Buessing suggests producers take pictures of their fields. But he warns not to expect good-looking pictures the first year. Over time the pictures he's taken provide a visual comparison of how variations in timing and practices influenced weed pressure, erosion and final yield.

Buessing also uses check strips in his fields to further differentiate where cover crops were planted and where they weren't. But his biggest indicator of positive changes occurring under the soil surface comes through soil testing.

Buessing relies on data from the Haney soil health test. In October 2015, he had 14 soil samples from 14 different grids on six different farms analyzed. Nine samples scored between 15 and 20 and two scored more than 20, signifying "very good" (around 15) to "excellent" (anything above 20).

"My samples have really improved since I started intensifying my cover-crop blends and rotations," he says. "My soil tests indicated my organic matter has improved by 1% in 3 years."

Measuring Profitability

With continued success in improving organic matter, increasing yield and achieving solid rate of gain, Buessing continues to experiment with different types and blends of cover crops.

This includes an experimental plot where he seeds more than 40 different varieties and mixes of cover crops each year. This plot helps him gauge which cover crops are performing well under the year's climatic conditions and which co-exist well together in what amount.

He uses this knowledge as he works with Bladen, Neb.-based Green Cover Seed to prepare mixes specifically for his farm. The company's SMARTmix Calculator includes data on more than 70 cover-crop species, assisting producers like Buessing in selecting the ideal mix for their location, planting season, soil type and average weather patterns.

The calculator also helps him determine the rates of each species he uses in his mix. His fall cover-crop blend generally contains 1½-2 million seeds per acre, while his summer cover-crop blend is usually around 700,000-800,000 seeds, since he doesn't need to seed as heavily for species like grazing corn.

Buessing uses a percent of the full seeding rate recommended for each species in his mix so that his total seeding rate adds up to 120-130%, if he's grazing the blend. If the cover-crop mix isn't used for forage, he may only reach 70% of the full seeding rate, depending on what he's trying to achieve, he says.

Buessing now also works with his local NRCS agent to help measure the forage equivalent of his cover-crop mixes. Last year, Buessing measured his estimated pounds of forage per acre and growing days by clipping samples on Oct. 15 and weighing samples on Nov. 3.

For all the cover crops, except for the summer blend, he applied 50 pounds of N and 100 pounds of 18-46-0.

Buessing's estimated pounds of forage per acre ranged from 1,920 pounds for Selby Oats to 2,803 pounds for Bob winter oats on 64 days of growth.

His fall cover-crop blend was estimated at 3,878 pounds of forage per acre on 72 days of growth, and his summer cover-crop blend was estimated at 13,401 pounds of

forage per acre on 106 days of growth.

Buessing also measured the efficiency of a perennial cover-crop blend he planted in August 2010. That blend includes meadow brome, tall fescue, orchardgrass, timothy, meadow fescue, festulolium, pubescent wheatgrass, intermediate wheatgrass, grazing alfalfa, birdsfoot trefoil and big bluestem.

More Grazing Options

Buessing estimates this continuously cover-cropped field alone has saved him \$50 an acre in feed costs per year. His hope is to develop more perennial fields like this one that would require no added fertility, could be rotationally grazed and could feed as much as if they were planted to brome.

Buessing encourages growers to try out their own cover-crop mixes and catalog results through pictures, soil health tests and other measures. Buessing himself is continuing his cover-crop experimentation with pastured pigs and chickens to evaluate both the nutritional value of covers for these species, as well as potential profitability.



Right rate. Bill Buessing uses Green Cover Seed's SMARTmix Calculator to prepare his mixes and determine what rate to use for each species. His fall cover-crop blend generally consists of 1½-2 million seeds per acre, while the summer blend is around 700,000-800,000 seeds, as species like grazing corn don't require as much.

Most important, just like Buessing does each year at the Axtell American Legion, he asked them to share their results — both failures and successes — with others in order to turn those experiments into improved soil health and increased profits.

"Rye?" he asked. "The better question is 'Rye not?' You never know what you can grow if you don't plant the seed."

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MYCORRHIZAL FUNGHI AND CULTURAL DIVERSITY AND THEIR SIGNIFICANT INCREASE IN NO-TILL SYSTEMS

Originally written by Claudia Maurer et al. and published in TCS in February 2015

The Swiss trial site at "Oberacker" has been comparing tillage and ploughing systems for over 20 years and continually assess the quantity and diversity of mycorrhizal fungi in various different establishment types. The results reveal significantly increased species richness and diversity of mycorrhizal fungi in plots under long term direct seeding.

Since 1994, the long-term monitoring site "Oberacker" in Zollikofen (Switzerland), has had the objective to develop a method of cultivation of farmland which is economically, ecologically and socially compliant. Direct seeding and tillage systems should therefore be optimized taking into account the selection of varieties and crop rotation, the type and amount of fertilizer, selection and application of plant protection products as well as management of straw and green manure.

Soil organisms play a central role, especially in the success of a sub-till cropping system. Like earthworms, which contribute significantly to the structuring of the soil and the decomposition of organic substances, bacteria and fungi act as a "hub" for nutrition and plant

health. Nearly 80% of plants benefit from fungi living in symbiosis with their roots: these mycorrhizal fungi facilitate access to nutrients for plants, especially phosphorus, but also by making nitrogen and water available - thanks to their hyphae - giving access to even the smallest pores of the soil normally unattainable for plant roots. In return, plants provide the fungi some of the carbohydrates they have assimilated (energy). Most species of crops and pastures live in very specific symbiosis with AMF (Arbuscular Mycorrhizal Fungi). Nearly 270 species have been investigated worldwide. Their presence depends mainly on the soil type and the operating methods. That is why Mycorrhizal Fungi are considered bio-indicators of good agricultural soils. Promotion of specific communities of

mycorrhizal fungi may be an important factor to a bio-system that ensures efficient absorption of water and nutrients. The objective of this study was to compare the diversity of mycorrhizal fungi on plots operated for several years under direct seeding and of the ploughed plots, to determine the effect of cultivation, to identify the indicator species and to compare the results with the knowledge currently available.

Methodology

The long-term monitoring site "Oberacker" is located on deep brown soil. Six adjacent land parcels are seeded half on a no-till system and half ploughed. The crop rotation - winter pea protein crops, winter wheat, beans, winter barley, sugar beet and maize

silage - lasts six years. In February 2011, soil samples were collected from a depth of 0-10 cm on the twelve subplots. For each sub-parcel, a sample was selected from 20 collected over the entire surface (about 1 kg). The main crops sampled were: winter pea protein crops, winter wheat and winter barley, two parcels of a mixture of green manures composed of several species and succeeding previous crops of wheat volunteers and winter barley and finally a bit of peas and field beans.

Arbuscular mycorrhizal fungi spores were then isolated and identified by light microscopy. The spore density was determined for each case in number of spores per 100 g of soil air dried. Diversity has been characterized as an index for each type of crop and subplot.

Direct sowing leading to stable numbers of species and high diversity

A total of 39 arbuscular mycorrhizal fungi species were identified, including 38 in the no-till system and 25 in the ploughed system (Tables 1 and 2). The number of species identified in the various cultures (subplots) was between 15 and 21 under direct seeding, between 10 and 17 under ploughing. Comparing averages also showed that the number of MA species is significantly higher under direct sowing (average 18.5) than under tillage (average 13.2). In both systems, a higher number of species (21/17) was identified in winter protein pea plots than in winter wheat (17/15) of green manure mixtures succeeding in winter wheat (17/14) and barley stubble (15/11). In the green manure mixtures succeeding winter barley sowing and harvesting before following by the sugar beet, the number of species identified in the no-till system was also higher than that of pea protein plots, with respectively 21 and 20 species, whereas it was only 12 or 10 species in the ploughing system. In the case of planting following a preceding sugar beet crop, the explanation may lie in the fact that sugar beet is a species incapable of mycorrhization and during the beet harvest, the soil is strongly stirred in the top 10 cm. This effect appears, however, to be apparent in the ploughed fields regularly for the sowing of the main crop. In the case of direct sowing, the number of species remains

high and the interaction between plant and fungi seems to be more stable. Not only the number of species but also their frequency and density of spores are important criteria in the variety description (Table 2). The comparison of the average values of all types of crops (six subplots) shows a higher diversity index in the no-till system ($H = 2.49$) than under tillage ($H = 2.17$; Table 1) although the difference is not significant. In direct seeding system, the specific values vary between 2.12 and 2.86 depending on the cultures, and between 1.77 and 2.56 in the ploughed system. The H values calculated for direct seeding are comparable to those of previous studies in Central Europe with organic cultivation or grassland.

More species found in no-till

The list of species shows that about a third of species may be present regularly in both cultivation systems (Table 2, group A with 13 species and 12 species groups, gray background). The majority of species, 24, however, were found primarily or exclusively in the direct seeding (no-till) system. Among them, 11 species showed a relatively high density of spores (group B, green background) and 13 species of spores rather low density (group C, yellow backdrop). In the latter group, they have been mostly typical species of extensive exploitation and soil conservation work, or before any typical grassland environments. Among the 39 species or groups of species identified, only two were found primarily or exclusively in the ploughed plots (group D, brown backdrop).

Multivariety analysis clearly distinguished spore communities of both no-till and ploughed systems from each other. Organic carbon in soil (Corg), the cropping system and microbial mass are the variables that individually have the greatest influence on the composition of Arbuscular Mycorrhizal Fungal (AMF) communities. Among the chemical parameters, the Corg and pH were significant.

The influence of the cropping system on the AM fungi community is shown indirectly through other parameters, particularly through the highest organic carbon content of the upper layer of soil (0-10 cm) in the ploughed system. A high diversity of sub-till AM fungi

can have a positive impact on the uptake of nutrients by plants, especially phosphorus. Some of the observations presented in Table 2 were confirmed by the redundancy analysis: *Funneliformis*, *Caledonius* and *Paraglomus* sp. BE12 are grouped near the ploughed plots, while the majority of AM fungi species were significantly denser under direct drilling. Other species that were present everywhere (Table 2) showed a more or less close relationship with the no-till system (p. Ex. *Fu. Geosporus* or *Glomus aureum*), less with the ploughed system (p. ex. *Fu. mosseae* and *Claroideoglomus claroideum*). These observations concur with those of studies conducted in central Europe. The characteristic species that have been able to show for the long-term monitoring site "Oberacker" are *Septoglomus constrictum* for plots in long term direct seeding and *Funneliformis Caledonius* for ploughed plots.

Same species found in grassland

The type of use and the operating intensity have great influence on the AMF communities in agricultural soils: grasslands usually have a higher diversity than crops, extensive cropping increases the number of species, intensive rotations reduce them, and there are more species of AM fungi in uncultivated soil than in land which is cultivated. This latter finding confirms the results of previous studies on the long-term monitoring site "Oberacker": there is an increase in species richness and diversity of AMF in plots under direct seeding since they ceased ploughing in 1994. Several species are characteristic of a no-till soil and some are also typical of grassland habitats. One can designate *Septoglomus constrictum* as an indicator species of direct seeding long-term on this site. For ploughed plots, the characteristic species is *Funneliformis Caledonius*. Among the various cultures, we find that the number of AM fungi species is usually lower in plots of winter cereals (barley and winter wheat) than in those of intermediate crops (green manure mixtures, sown before harvest). A successful direct sowing system depends on a fertile living soil. Promoting AM fungi, particularly specific species and AM fungi groups could make an important contribution to this fertile living soil.

RAPESEED ASSOCIATED WITH PULSES AND THE MANAGEMENT OF NITROGEN

Originally written by Gilles Sauzet and published in TCS in March 2016

When we include pulses or beans in the cropping system, either as a main crop or companion crop, nitrogen management is at the heart of the strategy. Knowledge of the evolution of nitrogen build-up and nitrogen flows mobilized by the different cultures that can use it, becomes a major asset, especially in low-availability environments.

The inclusion of legumes in cropping systems should naturally lead to a limitation of mineral nitrogen and reduce emissions of greenhouse gases, this more or less short term. Nitrogen is also not the only benefit emphasized. A more global vision, leading to environmental improvement is primarily expected. Structural quality, biological, organic soil is taken into account and becomes an essential element in our quest for success of the system, highly dependent on the quality of implementation of crops and intercropping. Soil is at the heart of the approach and its fertility should allow obtaining robust plants, able to develop and express a potential appropriate to the context. The farmer must always act on the state and trends of the environment, soil and weather. In some areas, the more limited potential, it is in the interests of sustainability, reflecting the integration of levers able to pass a course in agro-economic performance, while moving towards an agroecological approach. Uncap yields under limited potential contexts is not impossible if the components of the environment is respected by integrating innovative levers suitable. The associated rapeseed now has some experience.

After several disappointments in particular linked to the absence of frost-free phases and non-destructive disabling plants in spring, it has become common practice in many farms of the AC networks. Expectations agronomic terms are the same as when rape is alone. However the associated plant should not compete with the crop. A balance needs to settle and why each species, in turn, must take advantage of the elements at its disposal.

Autumnal behavior

The objectives in winter entrance, as rape either alone or combined are the same: quick lift, good stand structure, root growth capacity, to facilitate dynamic aerial growth of oilseed rape for accumulating nitrogen and set up vis-à-vis competition from weeds and insect management. The fear is of course to have a cover of legumes that would compete with the growth of rape. The cycle associated species is offset from the cycle of rapeseed which induces non-concurrent phases of growth. The competition is rare once the implementation of rape is successful. It sometimes gets better behaviours associated rapeseed in biomass and accumulated nitrogen. This is the case

in waterlogged soils crusty. The legume, especially faba beans, helps to improve the porosity and emergence. The partner rape is rarely if ever limited nitrogen input or output of winter, unlike the single rape, mid to low balances and this, no one can talk of dilution; accumulated aboveground biomass in both cases is very close.

The competition rapeseed / legumes is extremely rare. The experimental results show a decrease of 5 units of nitrogen absorbed, which can be attributed to a favourable variance of green biomass alone rape. However nitrogen contents of measures and visual field observations (leaf colour) show a better nitrogen status of partner rape without that we can evoke a division between plants, but a better root condition and perhaps, some rhizodeposition.

Behavior in spring

The profit is expected in the spring. Indeed pulses, which normally must degrade in winter operation are assumed to improve the nitrogen stock in the spring, their C / N is low (9 to 15). The initial objective, through the introduction of legumes in the cropping system, either as a main crop, covered with intercropping or in combination, is to improve the availability of nitrogen to make profit crops, but also to enrich the rhizosphere and preserve the structural state, and organic soil pore.

Early tests indicate that rape can itself benefit from this. Its fall and winter behaviour is modified (deeper rooting, better nitrogen status) and often allows a more dynamic growth recovery in late winter. It therefore seems less



dependent on the availability of mineral nitrogen fertilizers and biomass and nitrogen accumulated in bloom are consistently higher in partner rape. Behaviour associated rapeseed, as seen throughout the cycle is improved. Rape can benefit quickly from an additional source of nitrogen that allows her to express a priori identical potential. If we compare the differences in nitrogen CAU (apparent coefficient of use), there is a better use of rape in nitrogen associated with legumes. Certainly fertilization is lower and may explain this. However the best root exploration is also a justified explanation.

Splitting closely studied

The results obtained confirm that bloom reduce the dose of 30 units does not disturb the growth and therefore in principle the establishment of the number of pods and seeds. In contrast to the stage G4, the associated rapeseed is less productive biomass and accumulated less nitrogen. Fractionation of nitrogen in combination situation definitely needs to be worked and reviewed. The good condition of winter rapeseed output associated not campaigning for a dose of the same nature that only rape, even in situations with low availability. However, we need to extend the absorption late flowering and maintain a more efficient LAI Post-bloom. At this level, the later contributions can be interesting. As such, some tests have shown that eliminating the late contribution (point E) associated rapeseed could be limiting (Spring 2014) especially when the late flowering is watered.

The results obtained confirm that bloom reduce the dose of 30 units does not disturb the growth and therefore in principle the establishment of the number of pods and seeds.

Work on the fractionation is ongoing. Maintaining the leaf area index during the late flowering stage physiological maturity is important to try to improve the thousand grain weight, component until now very stable as rape either alone or associated. To improve the

productivity in grains, grain number is decisive. The PMG tends to decrease when the number of grains becomes too large. It is therefore necessary to find ways to maintain, even in non-optimal climatic conditions. In addition and to date, the sulphur fertilization, as rape is alone or in combination, is identical. This aspect of the route has not been worked.

Rarely unfavorable productivity to the association

By incorporating legumes covered the rape, it is hoped to benefit from ecological interests. Competition vis-a-vis weeds, disruption of insects, the optimized growth rapeseed, throughout the cycle should result in better overall behaviour, which provides for expression of a potential at least equal to that obtained by only rape, but with a reduced crop management inputs. The graphs below show against the associated productivity gaps between rape and alone, associated oilseed rape has received 30 units of nitrogen and less, weed control programs or fall insecticide reduced. Certainly the differences are small but rarely associated adverse to rape. System robustness is noted in place. It gets as much or more with less. This is confirmed by tests performed by farmers plots (graphs below cons) in Berry.

By incorporating legumes covered the rape, it is hoped to benefit from ecological interests.

These comparisons confirm the reliability of this practice. When the associated rapeseed compared with a reduced route (nitrogen / insecticide / weeding) yields similar results to a single rape with complete ITK. This success is completely linked to the rape installed. Since its implementation is successful, his behaviour is optimized either alone or associated. Of the association are expected agronomic and ecological benefits. By cumulative effects or interactions with the integration of other levers, improvements are expected on the ground and the culture system.

In production areas where both agronomic and economic performance

are average and irregular, this positive development of the environment and the care given to crop establishment, must be able to uncap insufficient returns. Inevitably, evaluating the potential created will influence the forecasts of nitrogen fertilization in particular. Our goal is to characterize the evolution of fertility medium to produce more with less or much nitrogen. For this, it is appropriate to know the fate of nitrogen accumulated and returned by legumes in the cropping system. This work is ongoing with holdings in Berry in particular networks.

The introduction of legumes, an important issue

Place rape is sometimes questioned or discussed in some historical production areas. We must find new production methods, new sources of fertility. We must act on the course culture and its success depends on securing its implementation and introduction of new levers to improve its growth and behaviour with respect to bio-aggressors. The introduction of legumes is an important issue that we must evolve both in technical route productivity. There remain issues to work or refine as the optimal destruction phases covered, the amount of accumulated biomass necessary, assessing the performance target may be different from one rape, splitting nitrogen ...

This paradigm shift therefore suggests positive developments regarding rape culture but also the accompanying crops in the rotation. Indeed the integration of legumes rapeseed will not by itself transform the usual results, but participate as well as the introduction of other innovative practices (intercropping covered more permanent cover, differentiated management of intercropping with work and not work, lengthening the rotation when possible ...) to improve the environment and productivity. Establish robust crops on a carrier floor production should allow to increase the potential in a context of respect for the environment. Grow or so becomes an obligation in certain soil and climatic contexts. Changing practices across culture and system must facilitate this success.

HORSCH, A RETURN TO DIRECT SEEDING

Originally written by Frédéric Thomas and published in TCS in August 2015

While this may be a surprise many, Michael Horsch is first and foremost a farmer, not a designer and manufacturer of agricultural machinery. The opening of East Germany after the fall of the Wall in 1989 allowed him and his family to expand its farming and implement new equipment and test its expertise, while refining its farming strategies. Therefore, his outlook, his analysis and action have always been oriented towards the search for efficiency for farms. A pioneer in simplifying tillage 30 years ago with the Seme-Exact, today it is the management of soils and the development of a comprehensive approach involving the location of traffic that leads back to ideas around tillage.

From the Seme-84 through the Delta Sem and soc Duett (PPF) to the Terrano and Focus (a form of strip-till) it is looking for solutions that are efficient, sustainable and consistent agronomically which motivates Michael Horsch. Although his company is still growing and takes the majority of his time, he has always kept his "eye in" as a farmer. The management of the company farms in the former East Germany and the Czech Republic continue to challenge the way he thinks and mean he has to continually refine his agronomic strategies. It is this collaboration between the field scale tests and the machinery industry

that enables the design and development of appropriate technical solutions. This attitude is shown in the way he has tackled the world of spraying, where he does not hesitate to challenge convention by proposing to greatly reduce the risk of drift by tracking the spray target. It is sufficiently accurate to develop a proactive boom height management system to maintain height above the vegetation to less than 25 cm. In terms of tillage, Horsch has endeavored to propose solutions for the reduction of the number of passes and therefore the costs of establishment.

In this context, direct seeding has been studied and comparing devices following standard practices on the Schwandorf family farm operating in Bavaria has produced reliable results. It shows that under these specific conditions and without peripheral changes, it is this approach in min-till to 20 cm which is the most effective in providing consistent results, even a slight performance gain while providing mechanization savings (25 l / ha fuel economy compared to ploughing). This notion is also a very important issue in a world where the price of land as an input requires a reliable operating system,

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Learning Maize Cultivation

With the acquisition of a farm in the Czech Republic in 2002, Michael Horsch was faced with growing maize in clay soil. This experience promoted the use of the strip-till, but also the idea that it is important to minimize traffic. With the acquisition of another farm north of Prague also on very clayey soils, it definitely became worth investing in the location of the traffic (controlled traffic?) of all passes with a correlation on the land between sprayer (36 m), tillage and drill (12 m). This new experience enabled him to understand and then demonstrate that it is primarily the wheels and trafficking, particularly in clayey soil, which requires remedial action to the ground to recreate a porosity and become even easier to till in the next run. Therefore, if the movement of machines is firmly confined to less than 15% of the area (target of only 10%), the soil retains its structure and porosity. The removal of deep work becomes possible and min-till becomes feasible. It is particularly interesting that in CTF (Control Traffic Farming), one must be able to work and sow especially with the equivalent width of the cutting combine to facilitate alignment of the passes.

Weed Grasses - And Resistance Develops

The second concern is the weed situation in Northern Germany and other major grain Eastern countries. Grasses, in France, are widespread and are becoming



Captions



Captions

resistant, control costs are becoming too high and therefore dead ends appear in farming practices. Even if the rotations are a little tight, it is increasingly clear that it is not intensive tillage that is the solution. Rather, it appears that a strategy of non-disturbance of the soil at planting, removing the operation that triggers germination, is more suited to reducing the weed grasses; another plus point for direct seeding. This is a form of holistic approach based on the location of the traffic and decreased risk of weed grass always in combination with a search for efficiency and reduction of production costs which lead to Michael Horsch's interest in tillage. With Horsch's communication strength and newly developed machines, it is certain to positively move this issue at European level and to change the perception of many farmers and technicians.

Development And First Sd Seeder Trials

After the design of a first seeding element for Direct drilling in 2013, Horsch built a drill prototype in 2014 that worked that autumn in Haute-Marne to test and validate the options he considered. After this first round using discs, two new machines, with the latest developments, were trialed in summer and autumn 2015 in the same area and also with clients elsewhere in France. The idea is to challenge the technical choices in different conditions. In parallel, other farms in similar situations are running tests in Denmark

and Germany

To limit soil disturbance while maintaining good control of the sowing depth, the single disc solution has become fact for Horsch. While considering the approach of the JD 750, which has been widely tested, Michael Horsch and his team adapted their drill so that it met their specifications and injected their expertise in the design and construction. The support arm is cast steel to give it more rigidity. At the front it is attached to a square section bar by a flanged system and rubber pads. This choice now has well proven reliability and acts as a damper to stabilize the machine and also individually each element. The penetration pressure is hydraulically adjustable from the cab made possible by pivoting the support square on itself. It should reach 200 kg / coulter. In terms of disk opener, the Horsch has chosen a large diameter (480 mm) to better cut through trash but the working angle has been reduced to a small angle, again to minimize disruption to seeding. The gauge wheel that is attached to it is a smaller diameter (400 mm) and wide enough (115 mm) to be as effective in controlling the depth in previously worked soil as in post-harvest stubble when seeding Direct. Finally and still for reasons of reliability, the bearing is also of a large diameter (65 mm) in an oil bath and with two tapered roller bearings in order to better absorb the lateral forces. The seed boot adjoining the disc was also slightly refined for the same reasons. It is protected by two tungsten plates and is

adjustable in height relative to the disc (3 positions). Finally and like the original, the seed is stopped and pressed in the ground by a wheel that follows in the groove. This is, however, equipped with a scraper and is retractable if the sowing conditions do not allow its use. Then the groove is closed by a side wheel, which it is possible to adjust for pressure (3 positions).

Beyond these elements, the originality of the direct sowing Horsch line is the integration of a sweeping tine at the front. This option is not yet finalized really in shape but it is certainly useful to establish seedling lines including through straw for rape or to sow in straw covered stubble immediately after harvest. The location of fertilization is also integrated to compensate the non-mineralization through cultivation at planting. The drill will be equipped with two hoppers with placement of the fertilizer into the same groove. For now only the solid fertilizer version was available. Finally the frame, which we believe now has been completely finalized, will carry fixed hoppers and retractable hydraulic coulters. Horsch has already integrated



Captions

in the design integrated ballast masses on the front and rear hoppers. Although this prototype is not yet completely finalized, it is already very functional and will perfectly

fit into the overall strategy defined by the manufacturer / German farmer. Mr. Horsch is investing convincingly in the market for no-till seeders.

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INNOVATIVE FARMERS LOOK FOR ALTERNATIVES TO GLYPHOSATE TO TERMINATE COVER CROPS

Anglia Farmers are running a new field lab through the Innovative Farmers network, investigating alternative ways to terminate cover crops.

Many farmers rely on the chemical herbicide glyphosate to destroy unwanted crops at certain points within the crop rotation, but with uncertainty over its future availability there is a desire to find new methods. These Innovative Farmers are getting ahead of the curve and finding new ways to establish a successful minimum tillage system without the use of chemical sprays.

For organic farmers, finding ways to reduce their reliance on ploughing will help to enhance soil health further and potentially reduce overall use of fossil fuels for successful crop establishment.

Lara Clabburn, Anglia Farmers Group Coordinator said; "This field lab is very exciting as it unites all farmers in finding better ways to cultivate soil, establish crops, maintain or improve soil structure and ultimately increase profit margin. It is already catalysing new ideas for cover crop destruction and preparation for crop establishment. The aim is to find and develop new tools which will help us to reduce our reliance on glyphosate."

Already several organic farmers have

joined the group and the field lab is expected to attract attention from both organic farmers looking to do more minimum or no tillage, and conventional farmers wishing to reduce their reliance on glyphosate.

One of the participants of the field lab group is Andrew Woof who is a member of Organic Arable and farms 500 acres of organic, mostly arable land at Weston Farm in Oxfordshire. After reading about work in Japan and the US, he plans to use a roller crimper to turn his cover crop into a weed suppressing and nutrient providing mass of stems. He can then drill directly through it, meaning no plough, and minimum compaction.

Andrew said; "I started looking for a way that I could improve my soil by enriching it with biomass and keeping soil disturbance to a minimum – So reducing compaction and preventing nutrient mineralisation.

"Joining Innovative Farmers gave me the inspiration to start thinking of things from a different angle. I hope that, through the field lab with Anglia Farmers, we might be able to find some conclusive

evidence for using minimum tillage in soil management, resulting in carbon capture through increased organic matter and so an improved bottom line."

As well as trialling Andrew's suggestion of a roller crimper, the group will look at other techniques to reduce the use of glyphosate and help reduce input costs.

The network has a range of supporters, bringing significant knowledge and experience to the field lab. Research partners of Innovative Farmers include: ADAS; Duchy College; the Centre for Agroecology, Water & Resilience at Coventry University; the Food Security & Land Research Alliance; IBERS; Harper Adams University; Rothamsted Research; and the University of Bristol.

Innovative Farmers is part of the Duchy Future Farming Programme, funded by the Prince of Wales's Charitable Foundation. The network is backed by a team from LEAF (Linking Environment and Farming), Innovation for Agriculture, the Organic Research Centre and the Soil Association, and supported by Waitrose



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UK DRILL MANUFACTURERS IN FOCUS...



Cross-slot technology emerged in New Zealand around 30 years ago, and has evolved through intense university research in both New Zealand and the USA. It has been field proven in more than 17 countries

In concept, the technology allows farmers to place seeds and fertiliser very close together in an optimum environment to encourage seed germination and establishment, by using an 'inverted T' slot. In 2012 Primewest Limited built its first UK designed drill. Now 3m, 4m and 5m grain only drills are produced, large seed hoppers, hydraulic control systems and sophisticated electronics including ADF and memory valve functions complete the package, with liquid fertiliser and micro-granular hoppers as optional extras.

The Technology

The key part of the technology is the Opener – the part of the machine that engages with the soil. A 22 inch diameter steel disc is supported in a parallel linkage. Each side of the disc is a cast iron blade; the blades are pressed against the disc by rubber pads. The blades are hollow, allowing seed or fertiliser to be blown down to the lower edge of the blade, where the small wing forms a horizontal slot in the soil. The depth of the Opener is controlled by two rubber tyres, negative air pressure press wheels, making the depth easily adjustable. The disc, press wheels and main pivot points are all supported on the same size taper roller bearing and sealed against contamination by a triple lip seal. Each opener is lifted in and out of work by a hydraulic ram, controlled by a memory valve, to ensure it is returned to the soil at the same pressure every time. The features of this opener make it unique with many advantages over its competitors.



The Environmental Benefits

The challenge to world agriculture over the next forty years is to increase output by 50%, whilst inputs are going to become more costly and limited. We must also produce a higher quantity of food whilst improving our soils and environment. True no-tillage can go some way to mitigating these problems. The most obvious savings are that of fuel and time.

One fault in many soils is that they have become overworked, meaning it has been tilled too many times to produce a good seedbed. Tilling has many detrimental effects; mixing air with soil accelerates the breakdown of organic matter. Organic matter is a key element of a fertile soil. Earthworms and other invertebrates feed on the organic matter and distribute it through the soil profile. Their burrows not only aerate the soil but provide channels that improve drainage, important when we are getting heavy rainfall events. A soil rich in organic matter can absorb more water, releasing it to plants when required but

also helping to bind soil particles together, helping to prevent water runoff and soil erosion.

Soil is a very important natural resource, made up of a complex balance of micro-organisms, which can easily be destroyed. By using true no-tillage we have the potential to manage and use soil properties more effectively.

To achieve the highest return from this technology, and to keep the soil biology working, farmers need to change to adopt longer and more diverse rotations by using both winter and spring crops, cereal and broadleaf plants and cover crops wherever possible.

The Openers allow crops to be established with the minimum of soil disturbance, this reduces weed emergence. This ultra-low disturbance approach will in a very short period start to improve soil biology, releasing more nutrients to the crop. The savings in fuel and time are immediate but larger savings in agricultural chemicals and fertiliser applications soon emerge.

Vaderstad's Carrier Working on Blackgrass Prone Farms

Vaderstad know that farms and farmers have to be flexible, that there is no one solution to suit all farms and therefore farmers need to find the system that works for them on their farm. Pure Direct Drilling just won't work in every case and farmers need to find out what works for them. From this they have seen that creating a stale seedbed is one of the most important elements to contain blackgrass to a manageable level.

The development of herbicides has enabled arable growers to break all the rules; they have been able to 'farm out of a can' as their prime means of weed control, rather than using rotations and other cultural methods. One of the results of that reliance on chemicals is that blackgrass has become an extremely serious problem on many arable farms.

David Taylor of Waterloo Farm, Fringford, found himself in this situation, where he grows 2000 acres of combinable crops; winter wheat, hybrid winter barley, oats, beans and oilseed rape in a rotation to fit the ground. David says:

"The blackgrass problem, especially on the heavy land, has changed the way we farm,"

"To contain the weed to a manageable

level we still need herbicides, but alongside cultural control, where it is extremely important to get a good chit; creating the stale seedbed is one of the most important jobs on the farm."

Five years ago David moved the target autumn drilling date from September to October to extend the length of the chitting period. But the issue of actually creating the best stale seedbed, on soils that run from brash to clays, was addressed 11 years ago.

"We were running a set of heavy discs followed by a tined cultivator," he explains, "but it was difficult to set it to move only the top two inches on the heavy ground. I always wanted an implement that just tickles the ground cheaply and quickly. A neighbour had a Vaderstad Carrier and we tried it out on 200 acres of hard heavy land and it made the seedbed I was looking for. The number of discs on the Carrier means it creates only a shallow tilth, but also chops trash and produces a good soil/residue mix."

The outcome was the purchase of a 5m Carrier which then was replaced it with an 8.25m-wide L825 model last season. "We chop and spread the majority of the straw and to get as long a chit as possible - the longer the better - the Carrier goes in as soon as we can behind the combine," explains Mr Taylor.

"We go down only two inches on stubble but the Carrier is a multi-functional tool; it'll happily create four to five inches of tilth on previously worked ground.

"We still have to go deep to maintain drainage, so we leave the field for as long as time allows after the Carrier before cultivating down to about nine inches with a disc/tine implement fitted with a double press to firm the ground, a sequence that gives us a good volunteer and blackgrass chit. We apply glyphosate before and after the deep cultivations and in front of the drill."

In addition to the longer and better stale seedbed David Taylor is also using varieties in his battle against blackgrass. "This year we have 500 acres down to hybrid winter barley, our second season with the strain," he says, "it's extremely prolific in the spring and out-runs the black grass. And I'm considering going back to two winter barleys in the rotation; it will enable us to start combining in July and give us an even longer stale seedbed."

On Farm Machinery

When the time came to replace the Carrier David did look at another make of shallow cultivator but decided to stay with "what they knew". Working behind Waterloo Farm's John Deere 8345R or Case IH Puma 230 the additional width of the Carrier L825 will enable it to easily keep up with the combine, a New Holland CR9080 with a 9.1m table.

Output will be around the 200 acres/day mark," comments operator Russell Deeley. "It also means that if we have only a two to three hour window we can get an appreciable amount done, which all helps with timeliness."

Mr Taylor adds: "I can't think of another cultivator with the Carrier's versatility, one that enables an extremely shallow cultivation and levels and firms the ground. It has made all our other cultivations implements virtually redundant and enabled us to practice a cultural and chemical programme that keeps our blackgrass to a manageable level."



Operator Russell Deeley (left) and David Taylor, who comments: "making a stale seedbed is now one of the most important jobs on the farm".

UPCOMING EVENTS

- | | |
|--------------------------------|---|
| 22nd March 2018 | Biochar: Measuring Effects on Soil and Animal Health - Cirencester - https://innovativefarmers.org/events/ |
| 27th March 2018 | GREATsoils field day: Using green manures to optimise nitrogen availability... - Ormskirk, L39 1PD - www.soilassociation.org/farmers-growers/technicalinformation/improve-your-soil/greatsoils/greatsoils-events/ |
| 8th May 2018 | Issue #105 of Practical Farm Ideas |
| 9th May 2018 | Innovative Farmers Network Day 2018 - Sheepdrove Farm, Berks - https://innovativefarmers.org/events/innovative-farmers-network-day-2018/ |
| 17th May 2018 | LEAF IFM Field Event: Boosting Business Success through Biodiversity - Elveden Farms Ltd London Road Elveden, Thetford IP24 3TQ - https://leafuk.org/news-and-media/events/leaf-ifm-field-event |
| 5th June 2018 | NIAB TAG South West Open Day (arable) - Devon - www.niab.com/shop/civcrm/event/info?reset=1&id=2766 |
| 13th and 14th June | Cereals 2018 - Chrishall Grange, Duxford - www.cerealsevent.co.uk |
| 19th June 2018 | NIAB TAG South Open Day (arable) - Hampshire - www.niab.com/shop/civcrm/event/info?reset=1&id=2767 |
| 21st June 2018 | NIAB TAG Morley Open Day - Norfolk - www.niab.com/shop/civcrm/event/info?reset=1&id=2761 |
| 26th June 2018 | NIAB Cambridge Open Day - Cambridgeshire - www.niab.com/shop/civcrm/event/info?reset=1&id=2754 |
| 27th and 28th June | Groundswell 2018 - Weston, SG4 7AL www.groundswellag.com/ |
| 28th June 2018 | NIAB TAG Croft Open Day - County Durham www.niab.com/shop/civcrm/event/info?reset=1&id=2762 |
| 8th August 2018 | Issue #106 of Practical Farm Ideas |
| November/December 2018 | Future of Farm Thinking Conference |
| 5th November 2018 | Agri-Tech Week 2018 - save the date |
| 28th/29th November 2018 | Croptec 2018 - https://www.croptecshow.com/ |
| 4th/5th December 2018 | AHDB Agronomists' Conference - https://cereals.ahdb.org.uk/events.aspx |

CLASSIFIEDS



HORSCH CO8

Horch co8 year 2003 in good condition go straight to work, radar metering, with new seed drive motor recently fitted, full set of blockage sensors, hydraulic markers plus pre em, full set of cleated tyres on packer in good condition. £9750+vat call 07792049734.



3M SIMTECH T-SEM 300AP

No till drill. In excellent condition. Has only done 340ha. It has the Sulky electronic metering system and radar. It is very simple to calibrate. There are 16 tines and cutting discs. Tractor mounted. Needs a very low HP tractor. Rear roller and chain drag to cover slits. Has been stored undercover and has been very well looked after. Almost new condition. Only one owner.



CLAYDON 3M SR DRILL 2007

Excellent condition. Carefully looked after by owner /driver since 2010. Stored undercover. This drill was the start of fascinating journey into soil health which has got us to where we are today. Also included is a comprehensive range of spare parts including bean kit, 3 inch spoons, 5 & 7 inch shares, covering tines. This drill has been used mainly on kind land and has had an easy life. Act quick to be sure of getting extra Brownie points from Mr Gove! Viewing welcome, sensible offers considered. Price plus VAT



SUMO - DTS3

Sumo DTS3. 2014 model upgraded to 2015 ORGA spec. Complete with 5" dual and 1" coulters. 450Ha



JOHN DEERE - 750A

Width 3m, Year 1999. Very good condition and well looked after. Has Guttler wheels plus extra Guttler weights on each wheel. Has been refurbished in the last 3 years, most moving parts are nearly new. Current discs have done 800 acres. Has bout markers. Liquid fertiliser system to go with drill. 750l tank, 2 electric pumps. Can apply liquid down to rates as low as 30l/ha. System made by Surefire Ag. Its an excellent addition to the drill. Stocks slug pelleter not available with the drill.



SUMO - 4 METRE VERSAPLUS

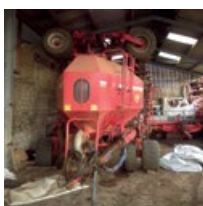
Complete drill outfit for sale due to change in policy. 2007 Xerion 3300 with 5980 hours, 2013 4 metre Sumo Versaplus drill fitted with 2016 S&K liquid fertiliser kit. Excellent system would sell as whole or split.

Drill has 6 subsoilers legs, 2 cameras, variable pressure coulters, the ability to lift alternate coulters and sow either side of the subsoiler leg for double row spacing.



SUMO - DTS 8M

Sumo DTS 8m, 2013 year, very good condition, 2 sets of legs, has been well looked after. 2779ha work done.



SIMTECH T-SEM 300

SimTech T-Sem 300 direct drill. Only selling as new one ordered.

Used here for 4 years, drilling cereals, swedes, grass, Glaxir margins and turnips, both DD and into cultivated ground. It really does sow any seed into any surface, as the manufacturer claims.

New points fitted in April and only drilled about 100ac since.



SUBSOILER: SUMO - LDS 4M

Sumo lds 4m auto reset gls tines flat packer roll. Very good condition



SUBSOILER: TECHMAGRI PROFILAB

Technagri Profilab

Low disturbance Michel leg subsoiler.

4m wide hydraulic folding, with twin wavy disc on rear.

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