

# A delve beneath the covers

## Technical Agri-intelligence update

Cover and catch crops get a lot of positive commendation, but what real benefits can they bring to the heavy land grower? *CPM* explores the findings of a major six-year project conducted at Agrii's Stow Longa Technology Centre in Cambridgeshire.

By Tom Allen-Stevens

**Almost anyone who's grown cover crops will have received mixed results and to be fair, that's par for the course when introducing any new practice into an arable system.**

What's particularly tricky, however, is refining the system, and understanding how to ensure they consistently deliver a benefit — even working out what a 'benefit' from a cover crop is can be a task in itself, notes Agrii trials manager Steve Corbett.

"60-70% of cover cropping on heavy land is almost certainly a waste of money," he states. "There can be serious confusion over what we're trying to do with them and a scatter-gun approach to growing them on farm. But there are valuable benefits if you know exactly what you want to achieve and you integrate them carefully into the rotation."

Steve and his colleague, David Felce, have been sifting through six years of data,

accumulated across 618 plots in detailed cover and catch cropping trials drilled, assessed and harvested at Agrii's Stow Longa Technology Centre in Cambs. For almost 20 years, the site has been at the centre of the company's R&D into blackgrass and cultivations. Since 2015, a significant strand of this work has focused on cover cropping, and with the results now drawn together, *CPM* has joined the duo for a detailed discussion.

### Good soil structure

"We quickly realised early on that biology doesn't deliver benefits on its own," notes Steve. "Just as with a cash crop, a cover crop needs the basics of good soil structure and a well drained site. It also helps to know the specific conditions of the site you're dealing with and then tailor your approach to cover cropping to suit it."

The predominant soil type at Stow Longa is chalky boulder clay, David points out, with a high blackgrass burden. "It's similar to situations faced by a lot of growers, but the approach on a Cotswold brash or lighter soil, for example, would be very different. That said, we built our trials into previous work on cultivations, so in all we have around 7-8 years' worth of data from which to draw conclusions."

Soil analysis of the trial site itself reveals it's actually only 10.5% clay, with sand constituting almost half of what's classified as a sandy silt loam. "What makes it heavy and difficult is the silt content in the 75cm of topsoil overlying the impermeable clay subsoil," David explains.

Steve accepts that this has presented the

cover crops and cultivation routines they've explored with a bit of a challenge. "Time in the ground is a key component for cover crops. This site cools down quick and gets wet relatively early. Good seed-to-soil contact is also vital at establishment, and that's not easy to achieve on this soil in the summer. So, you're working with a narrow window in which you're asking the crops to perform."

The trials have compared a range of cover and catch crops with three cultivation-only routines, based on ploughing, deep cultivation and direct drilling preceded with a straw rake (see panel on p40). A Lemken Karat combination was used to establish the cover and catch crops, while a Sky EasyDrill was the direct drill chosen for the following cash crops.

Throughout the trial, assessments were made of the soil and blackgrass levels along with the financial results. "We frequently found the direct drilled area was very easily smeared with surface compaction obvious," reports Steve. "Also that cover crops can get in the way of controlling high levels of blackgrass — on their own they don't help against the issue, which supports all the advice that a range of control approaches are required."

It's getting these aspects right, along with establishment, that are essential for those looking to maximise the benefits from cover crops on farm, he notes. "It's best to focus on a small area to address a particular issue and get it right at first, before introducing them widely across the farm — there are too many factors that can skew the results and mask the potential benefits."

"The shallow, fibrous roots of phacelia, for example, won't go into a compacted layer, but wow, they can deliver fantastic friability in the drilling zone. Black oats and vetch can really make a difference, with the oats ▶

“60-70% of cover cropping on heavy land is almost certainly a waste of money.”



*There are valuable benefits from cover cropping for those who know exactly what they want to achieve, says Steve Corbett.*

## Stow Longa catch/cover crop trial layout

Year	Plot no.	2019-20	2018-19	2017-18	2016-17	2015-16	2014-15
Cultivation only	1	Plough	Plough	Shallow	Subsoil + Karat (shallow)	Min-till shallow	Plough
				Plough			
	2	Deep	Deep	Karat (deep)	Karat (deep)	Ribbed roller Direct drilled	Flat roller Direct drilled
				Subsoil + Karat	Karat (shallow)	Plough	Ribbed roller Direct drilled
	3	Direct drilled	Direct drilled	Straw rake Direct drilled	Straw rake Direct drilled	Straw rake Direct drilled	Straw rake Direct drilled
				Subsoil + Karat	Plough		
Cover crops	4	Oil radish @ 20kg/ha	Oil radish (Adios) @ 20 kg/ha	Oil radish (Adios) @ 20 kg/ha	Oil radish (Adios) @ 20 kg/ha	Oil radish (Adios) @ 20 kg/ha	Oil radish (Adios) @ 18 kg/ha
	5	Black oat and radish @ 20kg/ha	Black oat and radish @ 25 kg/ha	Black oat and radish @ 25 kg/ha	Black oat and radish @ 25 kg/ha	Black oat and radish @ 25 kg/ha	Black oat and vetch @ 25 kg/ha
	6	Phacelia @ 10kg/ha	Phacelia @ 10 kg/ha	Phacelia @ 10 kg/ha	Phacelia @ 10 kg/ha	Phacelia @ 10 kg/ha	Phacelia @ 10 kg/ha
	7	White mustard @ 10kg/ha	White mustard @ 10kg/ha	White mustard @ 10kg/ha	White mustard @ 10kg/ha	White mustard @ 10kg/ha	White mustard @ 10kg/ha
	8	Phacelia @ 5kg/ha + mustard @ 10kg/ha	Phacelia @ 12 kg/ha + mustard @ 12kg/ha	Phacelia @ 12 kg/ha + mustard @ 12kg/ha	"Mega Mix"		

Source: Agrii

▶ rooting aggressively close to the surface and vetch penetrating further down. Ideally, you'd look to plant a mix of 8-10 species to address a range of issues, but that would be prohibitively expensive."

Indeed, cover and catch crops are not going to deliver an easy route to a prosperous rotation on heavy land, he suggests. As evidence, Steve presents headline gross margin figures from parallel rotation trials in a neighbouring field at Stow Longa. Here, the plough performed best at an average 2017-2020 margin over all inputs and establishment costs of

£631/ha/year, followed by the deep pass system at £602/ha/year with cover crops trailing behind at £529/ha/year.

This was equally apparent with just cover crops ahead of the spring cropping in the rotations work, while they also failed to deliver on blackgrass: the plough returned 93 heads/m<sup>2</sup> on average, followed by the deep pass at 306 heads/m<sup>2</sup>, and 332 heads/m<sup>2</sup> resulting from using cover crops.

"Cover and catch crops don't appear to be delivering anything to the bottom line above what we can achieve through direct drilling alone," notes David.

"That's in a situation where no-till yield results have only just come up to the same level as those where we've cultivated, following six years building the soil structure."

### Blackgrass seed

With the cover-cropping trials, care has been taken with the trial protocol to ensure blackgrass seed return has been minimised — the Sky drill has been specifically chosen as a low disturbance option for the cash crop in spring and late autumn, for example, says Steve. "It's important always to be mindful of what cultivations are required for the cash crop and to carry these out in August ahead of establishing the cover crop. That means drilling is the only operation to follow, whether that's in late autumn or early spring."

Overall, across the six years of the centre's detailed cover and catch cropping trials, the plough-based routine averaged best at £620/ha/year with oil radish performing worst at just £389/ha/year — a reduction of 37% (see chart on p41). So, is this a death sentence for heavy land cover crops? Far from it, he says. "Some interesting differences come through when you drill down through the figures.

"Phacelia can perform



*The experience on chalky boulder clay is similar to situations faced by a lot of growers, David Felce points out, but the approach on lighter soil would be different.*

favourably over direct drilling on its own — it's a good safe bet to get the all-important friable tilth in that top layer so you don't leave the seed exposed in an open slot. White mustard proves a cost-effective option, but poses problems in the rotation with other brassica crops. That's a similar dilemma with using cereals as cover crops.

"But while mustard or phacelia perform best, there's still a net cost from using them averaging around £70-80/ha. So, is this a cost worth paying for sustainability?" Steve asks.

To answer this question, he and David have looked at other factors, such as soil organic matter (SOM). Samples taken in



*The shallow, fibrous roots of phacelia can deliver fantastic friability in the drilling zone.*



*Smearing and compaction can be a problem on soils that cool down quick and get wet relatively early.*

## Destructive benefits

Along with getting the establishment right, killing off a cover crop and knowing when the timing's right are pivotal to success, says Steve.

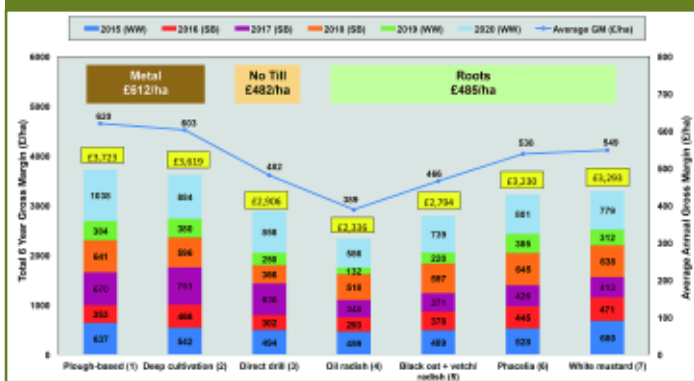
"When cover crops are breaking down, they can have a negative effect on the next crop, particularly spring barley," he notes.

To investigate this, a crop of Explorer spring barley was drilled on 30 March this year under the three different tillage regimes in the rotations trials at Stow Longa — ploughed, deep pass and direct drilled following a cover crop. In each case glyphosate was applied to the cover (or

volunteers/blackgrass) either four days or six weeks prior to drilling.

"The evidence here is compelling — there was a yield lift from the early application of 0.4t/ha in the ploughed plot, 0.5t/ha for the cover crop and 0.6t/ha in the deep pass leading to gross margin increase of £70/ha. When cover crops get to the point they're delivering the benefit you're seeking, that's the point to take them out — don't let them run on. And whatever the cover, it pays to spray it off well before the cash crop is established," concludes Steve.

## Stow Longa cover/catch crop trials 2015-2020: gross margins



Source: Agrii. Results shown across winter wheat (WW) and spring barley (SB).

## Examples of changes in microbes found in soil from Stow Longa

Microbe	Soil Organic Matter	Reduced Tillage + no Cover Crop				Cover Crop + min tillage				Effect on crop
		Plough-based (1)	Deep cultivation (2)	Direct drill (3)	Oil radish (4)	Phacelia (6)	Oil radish (5)	Mulch (7)	Black oat + vetch (8)	
Possible beneficial microorganisms	Bradyrhizobium	↓	↑	↑↑	↑	↑	↑	↑	↑	N fixing
	Versatimicrobia	↓	↑	↑	↑	↑↑	↑	↑	↑	N fixing
	Metarhizium	↓	↓	↑	↑	↑↑	↑	↑	↑	Takodell decline
Potential pathogens	Phytophthora	↑	↓	—	↓	↓	↓	↓	↓	Club root
	Flasmodiophora	↑	↓	↓	↓	↓	↓	↓	↓	cabbage club root
	Pythium A & B & C	↑↑	↑	↑	↑↑	↓	↓	↓	↓	Root rot – beneficial subspecies?
Pythium D	↓	—	—	↑	↑	↑↑	↑	↑	↑	

Source: CEH; samples taken in Nov 2019; arrow(s) indicate a comparative population increase/decrease which may be attributable to management practice.

Nov 2019 vary across the plots, but the results aren't necessarily what you'd expect: while phacelia comes out top at 4.4%, closely followed by black oats and vetch (4.3%), oil radish scores low at 3.5%. The plough achieves the site average of 3.9%, while the straw rake/direct-drilled area performs worst at 3.3%.

David emphasises that the results relate solely to this field and its soil type and shouldn't be inferred as a typical result any farmer would achieve. "We've not seen any solid evidence that the plough destroys organic matter. What the headline findings on reduced cultivations often miss are the situations that result in anaerobic soil conditions which can heavily reverse any gains in soil health and send your overall carbon equivalent emissions through the roof. On this soil type, that's far less likely to happen if you plough."

SOM is a valuable metric,

however, and he believes it's most informative when included as one of a range of soil criteria tested. "Only 8% of soil samples currently sent in to Lancrop are tested for SOM. Anyone looking to assess how their management practice can affect their soil should get this test done routinely to provide a benchmark against which to measure progress."

David and Steve recommend Lancrop's Solvita test, which includes a biological analysis with the physical scores and nutrient figures. "It combines critical criteria, like pH, P, K and Mg values, with aspects such as C:N ratio and microbial biomass, giving you an overall soil assessment score," notes David.

And it's here that some of the differences begin to show, with the cover crops delivering significantly better results than the cultivation-only regimes — microbial biomass for phacelia is

around 54% higher than for the plough, for example.

The findings have prompted the duo to delve deeper into the soil biology and the Centre for Ecology and Hydrology (CEH) is now working with Agrii in assessing the various microbes found in the soil samples from Stow Longa.

"Altogether, 62,000 different bacteria, 2000 fungi and 4000 eukaryotes (organisms that include the larger and more complex soil microbes) were identified. There were large differences in the soil community found between areas that had been tilled and the cover crop and straw rake plots," reports Steve.

These have been classed as possibly beneficial and potential pathogens, with cover crops showing an overall positive effect on the soil community while cultivations have resulted in a negative effect (see panel left). "We've expanded the scope of the study and CEH is now looking at up to 400 samples drawn from across farms under different cropping, tillage and organic amendment regimes. I think the results will prove interesting," he adds.

So what conclusions can currently be drawn? "Do cover/catch crops pay at Stow



Cover crops such as black oats and vetch can deliver a more favourable environment for the soil community.

Longa? No. Can they help with control of blackgrass? Possibly, but that's certainly not guaranteed. Do they improve soil structure? Yes, if established well, but don't expect higher yields as a result. Good seed-to-soil contact and early drilling are essential," says Steve.

"It's easy to knock holes in cover crops, but equally the findings of this study should be taken in context, and for those focused on what they're aiming to achieve, there are benefits to be gained. The really interesting one, and a 'definite maybe' is the effect on the soil community. There's a lot more to learn in this area, and as we do, that's where potentially greater benefits may come to light." ■

## Agri-Intelligence update

Through the country's most extensive agronomy research and development network, Agrii is focussed on delivering the extra value growers need in a fast-changing and increasingly challenging crop production world; value which keeps them firmly ahead in a future where overall cropping sustainability is at least as important as individual crop performance.

Following on from the series of articles developed from 2013, the company's R&D team have provided CPM with exclusive insights into findings from some of today's most practical crop improvement work.

This includes taking advantage of the best available variety intelligence; tailoring nutrition for winter and spring crops; employing new technologies and approaches to sustainable agronomy; and making the most of modern spring cropping.

We hope you find these insights valuable in helping you optimise your production costs; minimise your risk; take advantage of your best new opportunities; maximise your performance; simplify your management and, above all, secure a more sustainable farming future.

