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# Release the X factor

**AHDB**  
CEREALS & OILSEEDS

*from theory  
to field*

**Organic matter does something to the soil beyond delivering just a yield increase, but exactly what? CPM reviews the research that’s aiming to find out.**

*By Tom Allen-Stevens*

Soil organic matter (SOM) can be viewed as one of those nebulous but essential elements of agriculture. Rather like rainfall, you need it but defining exactly how much and when, let alone controlling

it, arguably lies beyond the scope of most terrestrial beings — even UK growers. What’s more, with SOM, there’s still a whole heap we don’t understand about its role.

“We know that SOM is critical to soil health,” notes Dr Amanda Bennett of AHDB Cereals and Oilseeds. “This isn’t just about providing nutrients for the crop, but about feeding soil biota. We know that SOM has been lost from many arable soils, and since this year is the International Year of Soils, there’s an increased public awareness of the importance of sustainable soil management as the basis for food systems.”

### Yield improvements

In 2012, AHDB Cereals and Oilseeds put in place £1.6M to fund a programme of soil-based research projects designed to deliver sustainable yield improvements for growers and unravel some of the mysteries of soil and crop interaction. One of these projects looks specifically at SOM and has just a year left to run (see panel on p35).

“By their nature, soil-based research projects often take some time to yield conclusive results, but we already have some significant findings,” she continues. “Importantly it’s shown that adding

amendments, such as compost, farmyard manure (FYM) or incorporating straw residues, does bring a yield benefit over and above the nutrient content of what you apply. What’s more, people think this takes decades, but the project has confirmed this benefit after just two years.”

Adding these amendments also brings a resilience to soils. “For me, this is the really important aspect — seasons vary and it’s at times of marginal conditions that SOM gives the soil the resilience it needs to sustain a crop.” ▶

*For Amanda Bennett, the main benefit organic matter brings is the resilience it gives to soils.*





*What's proved to be a real eye-opener for Andy Whitmore is the speed with which you can make a difference.*

► With a year left until the project is due to end, the research team is now focused on assessing the economics of applying amendments. "There's a misconception that growers should aim for a certain target SOM percentage — that's not what the project will deliver as there's no one-size-fits-all with organic amendments. Effects on soil microbiology are also seasonal and time-sensitive, and what you apply will depend on what's available.

"What we're aiming to deliver is a set of guidelines that will give growers a realistic idea of the difference applying amendments will make, as well as costings. But the project itself has also grown, and attracted additional funding and spin-off projects. So the value growers will get out of it will go well beyond what levy payers are actually funding," points out Amanda Bennett.

Leading the research at Rothamsted is Prof Andy Whitmore. For him, the ultimate aim is to learn more about the X factor SOM delivers to a soil. "If you increase SOM you get an increase in yield because of the nutrients it provides, but there's a greater increase than you can account for from just the nutrient value of the amendments. We know SOM can allow a soil to hold on to water, and helps make nutrients more readily available. So we set out to test this."

*Straw residue delivers effectively little difference over the control plots in terms of yield, but does help build soil biota.*



Over 200 plots have been set aside for the trials at Rothamsted, on land adjacent to the Hoosfield barley experiment that explores the long-term effect of different agricultural systems. Four types of amendments are under scrutiny in the new plots: FYM, compost, anaerobic digestate and previous crop residues. Across the site, five different nitrogen rates have been applied, while a rotation sees winter wheat, oilseed rape and oats and spring barley planted on the silty clay loam with flints soil.

"What's proved to be a real eye-opener is the speed with which you can make a difference through applying organic amendments — there's a confirmed yield benefit after just two years. In good seasons this can be as high as 2t/ha, and we actually broke the world wheat record in some of our plots where compost was applied this year with a yield of 16t/ha\*. But realistically, growers can expect an average yield boost of 1-1.5t/ha," reports Andy Whitmore.

### Leading soil improver

Compost is proving to be the leading soil improver, slightly better than FYM and digestate. "Straw is not doing so well, with effectively little difference over the control plots that receive no amendments. We're also trialling mixtures, and where straw is added to another amendment, this too has the effect of depressing the yield uplift."

The Hoosfield experiment (running since 1852) has borne out the difference SOM can make in a marginal year, he continues. "In years where overall yields are good, you can expect a 1t/ha yield benefit — typical barley yields were 8t/ha where amendments were applied compared with 7t/ha without. But in a year where the crop was hit by drought, for example, yields dropped to 6t/ha and 3t/ha respectively."

There are noticeable differences in the way the soil behaves, too. "Part of the project, funded by Defra, is looking at the draught force needed when ploughing. Where amendments have been applied there's a definite reduction in the force required to turn over the soil.

"Something you do see very quickly — within 12 months — is that water infiltration improves. So the anecdotal evidence you hear about soil structural improvements rings true."

Harder to gauge is the improvement in soil biota and what difference that makes. "Organic amendments act as a food source for earthworms and other soil organisms. Increasing SOM certainly results in more life in the soil and increases fungal growth, and that's as true for straw as it is for compost.



*SOM delivers a greater increase than you can account for from just the nutrient value of the amendments.*

But there's no clear relationship between an increase in earthworms and yield," states Andy Whitmore.

"Nor is the difference you make to a soil something you can measure very easily — I'd be inclined to move away from thinking there's some magic SOM content your soil should have. Taking a SOM measurement can be inaccurate as it can vary in the same field by 10-20%. You could be applying organic amendments for 4-5 years before there's any statistical change in SOM.

"But what does make a difference is to apply fresh material — that's what stimulates soil organisms more than a soil that has an inherent high SOM."

The large number of plots means the research team can assess quite accurately how the amendments influence the optimum applied N, however. "What we're finding is that it shifts the N response curve sideways and upwards — you can apply more and get more out of the crop."

The final year of the project will bring the data together, he says. With the crops on the site returning to winter wheat and spring barley, this is the same as those planted in 2012, allowing a direct comparison with the start of the project.

"We've noticed that organic amendments have a greater effect on spring crops, probably because they have less time to get their roots through the soil. In the final year we'll also be doing some modelling work to assess the minimum level of amendments needed to make a difference — we had a Dutch student join us last winter who's building in data gleaned from all over Europe."

And this is just one example of how the project has grown since it started, notes Andy Whitmore. "In monetary terms it's more than doubled, with investment from Defra, DARD in Northern Ireland and Waitrose. BBSRC and NERC are also funding work to see how long a build-up of SOM lasts."

Six fresh produce growers in the eastern counties are also running parallel on-farm

## Research round-up

### AHDB project RD-2012-3787,

Improvement of soil structure and crop yield by adding organic matter to soil, runs from Sept 2012 to Aug 2016. It aims to find the minimum addition of organic matter to bring about the maximum improvements in crop yield, and soil and environmental quality. Led by Rothamsted Research, with partner Cranfield University, its total cost is £1,470,982 with £774,999 funded by AHDB Cereals and Oilseeds and Defra, DARD, Produce World and Cereal Growers in the Waitrose Agronomy group providing additional funding.

### The AHDB Cereals and Oilseeds Soil Programme

is a four-year (2012-2016) programme with three projects investigating a range of practical and sustainable soil management practices. The work includes managing on-farm soil variability by using data from yield maps. Other parts of the programme are looking at how different types and quantities of organic matter influence soil structure and the effect of different cultivation techniques on the soil. There's a total investment of £2.6M, with £1.6M funded by AHDB Cereals and Oilseeds. Go to <http://cereals.ahdb.org.uk/soil> for more information.



*There's a confirmed yield benefit from applying organic amendments that can be as high as 2t/ha after just two years.*



*Organic amendments have a greater effect on spring crops.*

trials to assess the effects of different amendments on their crops. "We've had real engagement from the growers, some of whom have expanded their trials since the project started.

"The results on fresh produce won't be comparable with combinable crops, and

there are restrictions on the animal manure you can apply. But we're confident the project results as a whole will build into a useful combination of reliable figures and on-farm experience. Any grower should then be able to use these to help decide what amendment to apply and how much they'll need to make an improvement."

\* - Since the yield was recorded over a 6m by 9m plot, the 16t/ha gathered in doesn't qualify as an official yield record, and has been surpassed by other crops this harvest — read the full story on how Lincs grower Tim Lamyan beat both the wheat and OSR world yield records on p22. ■

## Compost brings SOM value on Yorks clay

A determination to improve soil fertility is what's behind a series of on-farm trials David Blacker's carrying out on his farm at Shipton, N Yorks. An AHDB Monitor Farm, there's 800ha of arable crops, on predominantly clay loam overlying clay.

"It's mostly low-lying, poorly drained land — not good in a wet season," he comments. "You can see from the yield maps that the best yielding areas are the most fertile, so about four years ago, I set out to try and raise the fertility of the soils in general."

SOM sampling, now carried out routinely, has shown the farm varies from around 2-4%. "But you can't take SOM at face value — 2% is low on our heavier land, but it's not a bad content for our lighter soils," notes David Blacker.

In the meantime, the farm has moved to strip-tillage from conventional cultivations — a 4m Mzuri drill and a low-disturbance subsoiler where needed are the only kit that disturb the soil. "We used to do straw-for-muck deals, but there was so much traffic on the fields that led to compaction. So now we chop all our straw."

As a trial, he's also applying compost at 37t/ha per year on one field and comparing progress with another in the same block of a similar soil type and with the same crop rotation.

"Annual testing in the field has shown the SOM is improving in big leaps — 0.5% per year.

Having said that, you have to question whether the test measures true soil organic matter, or just organic material."

But the yield benefits have been instant, too, with the composted field bringing in around 2t/ha more than the nearby control field. "This year we had phenomenal yields over the farm as a whole, with KWS Kielder wheat bringing in as much as 13.5t/ha. On the trial fields, Cassia winter barley yielded 10.5t/ha where compost had been applied and 8.6t/ha without," reports David Blacker.

But it's come at a price — at £5/t delivered and spread, he's aware the investment is barely paying for itself. "Financially it doesn't stack up. We're going to continue for the full five years, and there'll then be residual value we'll benefit from in subsequent harvests."

Meanwhile, he's also trialling cover crops. Four different types went in last year, for example: a Kings mix of oats, rye, vetch and radish; a DSV Terralife mix comprising radish, oat, sunflower, clover, serradella, phacelia, linseed, buckwheat and flax; Agrovista's black oat and vetch; and farm-saved spring oats mixed in with fodder radish and phacelia. The seed cost was around £50/ha for bought-in mixes, and £12/ha for the farm-saved one.

"The best mix was the DSV mix because it



*David Blacker has received instant yield benefits from his on-farm compost trials, but financially this doesn't stack up on its own.*

was so diverse. It grew to well over 1m high in places by Oct, but much of this was killed out by frost, allowing the smaller plants to come through that we sprayed off then drilled in March with spring beans.

"Although you can't directly compare the cover crops with compost as the fields have been cropped differently, the compost brings a much faster improvement in SOM and an instant yield benefit. However, I reckon cover crops win hands down — there's a better soil structure and they just transform the land."