

# Why organic matter builds resilience



## Agroecology conference

**What's the true value of organic matter? A Rothamsted researcher explained how it builds resilience in soils during the recent Hutchinsons Agroecology conference.**

*By Mike Abram*

**What is the true value of building organic matter in soils? For Rothamsted Research soil microbiologist Professor Andy Neal, it isn't increased yield or to gain access to carbon markets.**

Indeed, albeit perhaps surprisingly, Andy highlights that research suggests organic matter additions to soils don't increase yields in autumn-sown crops, although there's some evidence that it has a positive impact in potatoes and spring-sown cereals.

Evidence is also lacking that increasing soil organic matter will provide value through revenues from carbon markets, he says. "Yes, there's potential to sequester carbon, but it's not sufficient to make a dent in the real climate issues we have."

Instead, the real value lies in the

microbial interactions with organic matter and the impact on soil structure, he says, and the increased resilience that it can ultimately bring to soils.

Most soil organic matter originates from plant tissue, which goes through a complex cascade of degradation, first by shredders such as earthworms, then fungi and bacteria and other microbes.

### Sequestration

"The important part for organic matter sequestration in the soil is getting small enough molecules to be absorbed onto mineral surfaces and so no further microbial activity can take place," explains Andy. "Once it's locked away, it creates this wonderful structure that's vitally important to the way microbes work."

Andy studies at a scale smaller than the average diameter of a human hair, which allows him to focus on pore structure. "That's where the water holding capacity of soil occurs, because with pores that size, capillary action holds water in soil once it drains. But it's also where we see greatest enzyme activity, fine roots and organic matter being deposited directly from roots into soil, and mycorrhizae fungi," he says.

Detailed analysis has found that soils with less than 1% organic matter have very little porosity or connectivity between pores. "My suggestion is that connectivity in soils is what drives soil health. The more connected the pore spaces, the ►

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► healthier your soil will be as you increase organic matter.”

Just a 1% increase in soil organic carbon gives around a 354,000 l/ha increase in water storage capacity in the top 30cm of soil, he estimates. “There’s a real advantage to increasing pore space in soil, and the way you do that is to pump more organic matter through the soil, which the microbes use, break it down to a form that can stick to mineral surfaces and build this fabulous architecture.”

That holds true for clay soils, but less so for sandy soils, he notes. “In extremely sandy soils, research suggests that organic matter has virtually no influence on the soil structure because a sandy soil is made up of larger particles, all similar in size and shape, and you end up with huge voids in between those particles that can’t form any architectural structure.”

One benefit from improved structure is

that it allows the plant growth hormone ethylene to diffuse away from root tips, explains Andy. “If ethylene increases to a high enough concentration, it stops root growth. If you have a well-structured soil, you don’t get that and roots continue to grow so not only are you storing more water, you’re also allowing roots to explore more of it because there’s no barrier to their growth.”

## Rothamsted Broadbalk

But how you manage soils doesn’t change the soil’s intrinsic carbon to nitrogen ratio, according to evidence from Rothamsted’s Broadbalk long-term experiment, says Andy.

“All that changes is the more nitrogen you have in the soil, the more carbon you can sequester, so don’t worry about changing it as it’s under the influence of microbial metabolism and mineral content.”

Using CT scanning, Rothamsted was able to show the soil structure in the plots receiving high 35t/ha/year FYM inputs in the experiment was virtually identical to nearby long-term woodland and unmanaged pastures.

“So if you have enough carbon to hand, which is the challenge, you can still plough every year and have the equivalent soil structure at these small scales to pasture or woodland.”

The research also revealed that inorganically fertilised soils had only a half to two-thirds of the soil pore space, even at field capacity, compared with the plots receiving FYM. “In the FYM plots, because of the increased structure there was an awful lot more oxygen availability.”

That matters for nitrogen use efficiency, he explains, because when microbes run out of oxygen, they have evolved to use either nitrate or sulphate to respire. “When

## Food company investment

Together with farmer interest, there’s also been a surge in interest from food companies in transitioning their supply chains towards regenerative farming practices.

Major global brands such as McDonald’s, PepsiCo and General Mills are just some of those who’ve set seemingly ambitious regenerative agriculture targets, although companies in the UK are still only running pilot projects.

But a 2023 report by the FAIRR Initiative, a collaborative investment network that raises awareness of environmental, social and governance risks and opportunities in the food sector, suggested the food sector was making more promises than progress on regenerative agriculture.

The report found 64% of the 50 agri-food companies that publicly report on regenerative agriculture as an opportunity, don’t have in place formal quantitative targets for how they’re going to achieve those ambitions, and only 8% had financial commitments to support farmers in their supply chain to incentivise the uptake of regenerative agriculture.

Commenting on those findings, Shropshire regenerative farmer Clare Hill says it’s disappointing there’s a lack of investment at grassroots level.

“How can you make claims that you’re doing regenerative agriculture without actually investing in it?” she asks. “We require capital to start flowing in the right direction back down to the land from which it was first extracted.

“An additional observation is we often see

food brands want the same product, to the same spec, from the same breed. The onus is on farmers to become regenerative without food companies considering what changes they have to make in order to support that transition,” says Clare.

For many regenerative farmers, the more likely route of getting value from agroecology is to sell direct to reclaim the approximate 80% of the value which is used up in the supply chain, she points out.

“Innovation is rising in this area with hub models, such as the one Oooby [veg box platform] has created, showing impressive returns.”

The FAIRR Initiative report also found instances of companies using regenerative agriculture as ‘greenwashing’, which was something McCain Foods GB vice president James Young was keen for his company to avoid.

Globally, McCain has set the target of 100% of its potatoes being supplied by farmers involved in regenerative agriculture by 2030, including the 700,000t grown in the UK.

One of the ways McCain hopes to avoid falling into that trap is to make sure the marketing claims are made after plans, targets and frameworks for delivering the objective are set, says James.

The main reason McCain chose this direction was for the long-term sustainability of its potato supply, he explains. “While we’ve diversified to some non-potato products, we’re effectively still a potato business and therefore completely



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reliant on the supply of potatoes and good relationships with farmers, and by extension, soil health.”

The firm has established a framework of seven indicators to define what it considers to be a regenerative grower in the northern hemisphere, together with targets that growers meet to be considered at a beginner, master or expert level.

“But we leave flexibility for growers to pick and choose to make sure it is not prescriptive,” says James. Support for the grower base includes preferential financing through NatWest Bank, research projects designing new machinery to reduce cultivation depths and soil movement, as well as advice and support, he concludes.



## Charter to smooth transition hurdles

According to Hutchinsons' head of agroecology, Ed Brown, an encouraging surge in interest and adoption of regenerative farming practices is happening but has brought its own challenges.

Those challenges include risks for both farmers and agronomists. "Unfortunately, agroecological practices are often poorly understood and poorly implemented, which means it inevitably goes wrong sometimes with a potential loss of income for the farmer and liability for the agronomist."

That's why Hutchinsons is about to release its Agroecological Charter, he says. "The charter will clearly define the meaning of agroecology so all parties are clear on what they're trying to achieve, and secondly, detail some of the key management processes required to make agroecology a success, including objective setting and resource building.

"It will also highlight some key risks with implementing agroecological practices and the associated crop management, and how these risks can be mitigated. Our intention is the



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Charter will help to guide farmers and agronomists through and beyond the implementation phase to remove a lot of risk," he concludes.

they do this, they grow much more slowly, but for the farmer they're using nitrogen in ways you didn't expect, wasting money, and producing a lot of nitrous oxide."

When Rothamsted compared soils receiving FYM and inorganic fertiliser at equivalent rates, the FYM soils were releasing less than half the nitrous oxide, says Andy.

"So I think the greatest challenge you have as farmers looking for healthy soils is getting as much access to oxygen in your soils as possible. Fortunately, you can do that if you have sufficient organic matter or if you build it up."

All of those benefits — the better soil structure, greater access to water, oxygen and improved nutrient use efficiency — ultimately provide resilience, he suggests.

"You don't see that resilience every year, but when things get tough, you'll appreciate that resilience — and organic matter gets you there." ■

All people quoted either presented or spoke with *CPM* at the Hutchinsons' Agroecology Conference.

## Wildfarmed tweaks rotation plan

Growers will no longer be required to put fields into a three-year rotation as part of a Wildfarmed agreement after the firm discovered it was acting as a barrier to farmers signing up.

Wildfarmed is encouraging farmers to transition to soil-focused farming by following five core standards, which include growing cash crops, predominantly wheat, with either pulses or companions, minimising bare soil by growing cover crops and integrating livestock into the cropping system at least once in a three-year rotation.

The standards also specify that nutrition is based on requirement up to a maximum of 80kgN/ha and that no pesticides can be used on the growing crop.

Wheat grown to these standards is then sold to a range of customers from artisan bakers to Marks & Spencer, with farmers receiving a fixed premium price of £310/t in 2023.

The firm is also developing other premium markets for crops such as barley and oats, work that partly started as a result of planning three-year rotations in conjunction with its grower supply base, while continuing to offer annual grain growing contracts.

The gross margin from a three-year rotation of a legume-fallow (NUM3), which pays £593/ha under the Sustainable Farming Incentive options, followed by two Wildfarmed

bi-crops, for example, is an exciting prospect potentially, according to Wildfarmed cofounder Andy Cato.

However, the firm's assumption that working towards a three-year commitment would be required to drive systemic change is proving to be untrue with farmers often taking some Wildfarmed-led practices, such as bi-cropping and sap testing into their conventional fields.

In fact, insisting on a three-year rotation from the get-go on top of excluding the use of all pesticides and significantly limiting fertiliser use was creating a block on sign-ups, notes Andy. "Given our mission is landscape change, the last thing we want to do is create barriers. Perfection can be the enemy of progress," he says.

That means a Wildfarmed field can continue to be moved around the farm, with the firm suggesting growing Wildfarmed wheat, which has a lower protein spec, at the place in the rotation conventional milling wheat would occupy. Under Wildfarmed standards the no pesticide rule begins when the crop is planted, allowing glyphosate to be used pre-drilling.

"The Wildfarmed standards are a radical shift," says Andy. "They require a change of mindset, and changing mindsets requires successful outcomes.

"From the beginning the Wildfarmed standards were about supporting growers and



*Insisting on a three-year rotation as well as excluding the use of all pesticides and significantly limiting fertiliser use was creating a block on sign-ups, says Andy Cato.*

helping them to reduce the risk of trying something new on an area of the farm."

Further research has led to a second tweak in the rules to allow the 80kgN/ha to be all soil-applied, rather than the last 40kgN/ha having to be foliar applied. "What we found after looking at the sap analysis data, the costs, and farmers' experiences, was that insisting on foliar nitrogen was adding cost and complexity without any benefit."