> *"Not all soils are equal when it comes to carbon sequestration."*

An unequal playing field?

Internatonal Fertiliser Society

Nitrogen and carbon were hot topics at the International Fertiliser Society conference last December. *CPM* reports the highlights.

By Lucy de la Pasture

Nitrogen-use efficiency (NUE) is something that's on everyone's lips this spring as the steep rise in fertiliser prices concentrates minds on getting the most out of any bagged nitrogen. To shed more light on the issue, Renske Hijbeek, assistant professor at Wageningen University and Research in the Netherlands, discussed what's known about NUE in her paper presented at the International Fertiliser Society Conference, which took place at Robinson College, Cambridge last December.

She highlighted that the average NUE in crop production has fallen from around 70% in 1960 to nearer 50% in 1980 — a level it has continued at to the present day — meaning nitrogen use has become less efficient.

Her colleague, Dr Hein ten Berge looked at 549 nitrogen response trials to determine whether the shape of the curve could be best explained by Liebig's Law of the Minimum or Mitscherlich's Law of Diminishing Returns.

Hein found that Mitscherlich best described what was happening to yield as nitrogen input was increased. "High yield potential could be realised by a fixed amount of N, rather than an ever-increasing amount — something that may reassure growers who are cutting back nitrogen applications this spring."

Legacy effect

Renske has been researching what happens to synthetic nitrogen after it has been applied. "It's not easy to quantify so we needed to look at long-term experiments with a control and long-term fertilised plots. We added sub-plots to look at the short-term recovery of nitrogen using 15N-labelled ammonium nitrate."

Renske found there was a legacy effect from applying nitrogen fertilisers in 61 of the 66 long-term trials studied — in other words, some of the nitrogen not taken up by the crop is retained by the soil (SNS) and can be taken up by the next crop. She found this long-term recovery accounts for 24.4% of annually applied nitrogen. She also discovered that nitrogen recovery is different between crops, with winter wheat having greater recovery than maize or barley.

Rothamsted's Professor Andrew Neal and Professor David Powlson both presented papers which reached the conclusion that geological history alone, which determines the type of soil found on a farm, will make capturing more carbon in the soil "nigh on impossible" for some farmers.

Andrew said: "Not all soils are equal when it comes to carbon sequestration. If you farm on sandy soils, as is the case for farmers in places such as Bedfordshire or Nottinghamshire, then you will struggle to increase the carbon content of your soil in spite of adopting all the right management practices to get carbon flowing through the soil."

Common ways to improve soil carbon include the addition of manures or crop residues, growing cover crops in the winter and the rearing of grazing livestock and crops together.

Under proposals put forward by the Government as part of its post-Brexit shake up of UK agriculture, farmers would be paid to manage their farms using such environmentally friendly practices.

The problem is that the potential for carbon sequestration is strongly influenced ▸

Around 25% of annually applied bagged nitrogen is destined for long-term recovery by the following crop, explained Renske Hijbeek.

Limus®

Urease Inhibitor

LET SMART SCIENCE GROW YOUR PROFITS

Limus® Clear

+0.23t/ha yield
+£39/ha MOIC
(ADAS, 6 trials)*

Limus® Urea

Equivalent yield to AN (ADAS, 15 trials)*

MAXIMISE YOUR PROFITABILITY WITH INDEPENDENTLY PROVEN SCIENCE.

Available as Limus® protected urea and Limus® Clear for UAN. Limus® is a dual-active, innovative urease inhibitor. And rigorous ADAS Agronomics trials and BASF testing prove it's an innovation that works. By reducing ammonia losses, Limus® delivers equivalent yields to AN and increases the yield of urea/UAN fertilisers by 5%.**

Find out more about how Limus® can help your profits grow, visit agricentre.basf.co.uk/limus

BASF

We create chemistry

▸ by soil type — particularly texture — and the starting carbon content, which will be a legacy of past farming practices, explained Andrew.

"Changes in soil carbon in response to alterations in management practice occur slowly. It's also difficult to measure the likely small changes in soil carbon within a short time period; indicators such as soil microbial biomass are useful in showing whether organic carbon is increasing or decreasing in response to a change of management - but these measurements provide neither an estimate of soil carbon stocks, nor a prediction of absolute changes in carbon."

Carbon flow

David also warned that farmers who had already achieved high levels of soil organic carbon may be disadvantaged under government proposals because their soils would be unlikely to sequester more carbon.

Both academics believe the flow of carbon through soil, rather than the actual amount in soil at a given time is a more relevant way of assessing carbon — it's something Andrew calls a "dynamic rather than static" view of soil.

"If a system of policy requirements or financial incentives for increasing soil carbon is to be instituted, we propose an alternative approach using carbon models to predict probable changes in soil carbon taking account of the farmer's soil type, local climate, cropping practices and starting soil carbon content. This could be combined with closer monitoring at a network of benchmark sites."

Careful thought needs to go into designing replacements for current EU farm subsidies, added David, as there are formidable challenges to doing this in ways that are both fair and practical.

"There is much interest in sequestering carbon in soil as a means of mitigating climate change by making payments to farmers in return for the amount of carbon sequestered. There are several 'early warning' methods that may be successful in detecting whether or not a soil is increasing its carbon content, and this is helpful. But they will probably not provide direct evidence of the absolute change in total carbon that has occurred."

Physical structure, and resulting changes in biological activity, are less influenced by organic inputs in sandy soils, explains Andrew Neal.

Soil organic matter contains about 50% carbon and influences virtually all soil properties. Recent research using Rothamsted soils by Andrew and colleagues has shown how the structure of the soil is affected by the processing of organic matter inputs by soil microbes as metabolites form associations with mineral particles. The resulting structure in turn impacts oxygen diffusion through the soil and the microbial processing of carbon and other nutrients important for crop and livestock nutrition.

"Imaging of pore networks clearly shows how a clay-rich soil adapts to differences in organic inputs, but a sandy soil shows little adaptation. Thus the physical structure, and resulting changes in biological activity, are less influenced by organic inputs in sandy soils. This is consistent with the observation that sandy soils have much less capacity to sequester carbon than soils of finer texture," he said. ■

Zypar®

Arylex™ active

HERBICIDE

Zypar® provides reliable control of broad-leaved weeds in winter and spring cereals.

The combination of Arylex™ active and florasulam has set the benchmark in season-long cereal weed control.

Zypar works whatever the weather; so if you can get on, Zypar lets you get on, allowing you complete flexibility.

Keep your cereals in great shape, talk to your advisor or find out more at **corteva.co.uk/zypar**

CORTEVA™ agriscience