

# Becoming subterranean livestock farmers

“One of the key influencers of soil health is soil organic matter.”

## Roots Sugar beet soils

**Sugar beet is one of the most sensitive crops when it comes to establishment, so it makes sense to pay attention to soil health. CPM learns what's meant by soil health and how a sugar beet farmer is implementing it on his farm.**

*By Lucy de la Pasture*

Soil health is something everyone's talking about but there needs to be less talk and more action, believes East Anglian/East Midlands farmer Stephen Briggs, speaking in his role as soil and water manager at Innovation for Agriculture at the BBRO winter technical conference.

“A healthy soil is more than just a sum of its parts — physical, chemical and biological,” he says. “One of the key influencers of soil health is soil organic matter (SOM). The ability of a soil to store plant-available nutrients depends on the

soil's cation exchange capacity (CEC) and this is highly influenced by SOM.

### Nutrient retention

“Negatively charged particles of organic matter attract positively charged nutrients; such as  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{K}^+$  and  $\text{Na}^+$ , holding them in the soil until they are taken up by plants. So SOM helps improve nutrient retention and availability in soils,” he explains.

He uses a sandy soil with low levels of organic matter to illustrate the point. “This soil will have a low CEC, meaning nutrients are lost during rainfall and irrigation events.”

SOM also creates soil stability and increases soil biological activity, says Stephen. “Increases in soil organic carbon have been shown to be the predominant factor in changing the soil microbial community structure, functional diversity and activity.”

So is there evidence that SOM has an influence on sugar beet? The answer is yes. “Studies are beginning to measure different elements of the SOM complex; microbial biomass, soil respiration rates ( $\text{CO}_2$  on incubation) and microbial diversity. SOM and soil organic carbon (SOC) are not widely measured or

understood at farm level or used in relation to different management practices, but research is beginning to link SOM in more detail to sugar yield,” he explains.

Organic matter drives the soil food web that supports the living biomass that creates a healthy soil. Earthworms help improve porosity and drainage. ▶



*Stephen Briggs explains that soil organic matter has an effect on sugar yield.*



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## Growing sugar beet without the plough



*Dick Neale (left) and Simon Wilcox have changed cultivation practices on Simon's farm after an in-depth 'healthy soils' analysis.*

When Hutchinsons agronomist, Simon Wilcox took over the tenancy of Warboys Farm two years ago, he inherited soils that had been relentlessly ploughed and an imploding blackgrass problem. As an agronomist and also a farmer, Simon knew that he needed to address these issues head on and adopt both short and long-term strategies to improve soil health and lower the weed burden.

Inspecting soil structure is key to deciding on the most appropriate cultivation and cropping strategy for individual fields, says Hutchinsons soil health expert Dick Neale. "It's a great opportunity to identify the presence, extent and depth of any compaction, but also to evaluate other aspects like slug pressure for the following crop and general soil health.

"Simple things like looking at the number of worms, texture and smell of the soil can tell you a lot about what's going on beneath the surface," he says.

*The number of earthworms active in the soil profile is an indicator of soil health.*



Simon had very little historical farm data so opted for a full 'healthy soils' assessment to give him more insight into the state of the ground he was farming.

Hutchinsons Healthy Soils is a complete service that benchmarks and measures soil conditions in any particular field or farm, which then makes it possible to make decisions about management practices, and most importantly also allows the farmer to monitor and measure how particular changes are having an impact.

Part of the healthy soils approach is to visually assess soil cores of up to 1m in depth, which shows up any zones of compaction. An infiltration test is used to further identify structural issues and an assessment is made of the soil's texture and its cation exchange capacity.

The number of earthworms active within the top 200mm, a good indicator of soil health, is also recorded. The chemical health of the soil is taken into account, with measurements made of organic matter content, pH analysis at three depths — surface, 150mm and 300mm — as well as a full assessment of macro and micro nutrients.

"Generally, the soil was in fairly good condition at the surface, but there was a compacted layer at about 65-67.5cm depth, which had most likely developed as a result of heavy harvesting equipment," believes Dick.

"There was nothing that we could do to address this mechanically at this depth but non-mechanical methods, such as cover cropping, traffic management and improvements to organic matter placement to encourage earthworms, were areas we could work on to help improve long-term structure, drainage and water-holding capacity," he comments.

"The first step was to drop ploughing across the rotation and reduce the depth of cultivations, so that they're just moving the top couple of inches of soil," he says.

"For the cereals and oilseed rape this was relatively straightforward. But sugar beet is a different matter, with good establishment key and a crop that's particularly sensitive to soil cultivations. Getting good seed to soil contact in the planting zone is essential," he says.

The decision was made to strip-till the sugar beet which would provide this, while also leaving a significant area uncultivated so that grass and broadleaf weeds weren't disturbed.

"We recognised the challenges to taking this approach on Simon's heavier soils, but to address the soil health issues we had no choice," notes Dick.

"The first year we strip-tilled the beet in



*In 2017 beet emergence was patchy, so the newly adopted strip-till strategy has been tweaked for planting this spring.*

the spring using a Cousins MicroWing. We used a seed rate of 125,000 seeds/ha, aiming for a plant population of 100,000 plants/ha, and we were pleased with the results," says Simon.

Last year there was a much wetter period in early spring and because Simon doesn't have his own equipment, he didn't have flexibility as far as timing of drilling was concerned. As a result, the sugar beet was drilled into less than ideal conditions, resulting in some smearing and micro-compaction, with beet seed left sitting in cracks in places.

"Establishment was gappy and the crop didn't really perform as well as I would have hoped," he comments.

After two very different sugar beet planting seasons and mixed results, what does Simon intend to do next? "I know I can't go back to ploughing for at least five years if I'm to gain any benefits from dropping the plough from our cultivations, so this year we've tweaked our approach. We strip-tilled the soils in the autumn and have left them to overwinter, then once conditions are favourable in the spring, we'll strip-till again just to freshen up the strips. I've also made sure I have the flexibility with equipment to allow me to do this.

"In this way, we're keeping to the core principles of minimal soil disturbance and encouraging worms, but also ensuring that conditions are right at drilling. I hope to make some savings on herbicides as weeds only germinate in the cultivated strip, and in the long run the change in practice should significantly reduce the overall weed burden."

► “A worm cast contains five times as much N, 3-7 x P, 11 x K and 3 x Mg compared to undigested soil,” says Stephen. “Worms can deposit around 20t/ha/yr of castings and are 12% N. So 25 worms in a spade-full of earth gives you 20kgN/ha once they die.”

Mycorrhizae play another important role in healthy soils. Their mycelium network of

threadlike hyphae increases active root surface for nutrient acquisition by up to 700 times. They are also key to building soil structure, producing glomalin — a sticky substance formed abundantly on hyphae and spores of arbuscular mycorrhizal (AM) fungi — which binds soil particles together, he says.

So how can growers actively improve

the SOM content of their soils? By importing a good, long-lasting source of SOM, suggests Stephen. “One of the factors affecting the rate at which organic matter decomposes is its C:N ratio. Low C:N is quick and a high C:N is slow to decompose.” Compost contains high levels of organic matter, therefore builds long-term SOM faster than FYM but FYM ►

## Virus yellows threat in an era without neonics

There’s no doubt it’s a challenging time, particularly for sugar beet growers as the threat of a disease that has been under control for the past 24 years is set to re-emerge if neonicotinoids are banned. The message from the BBRO winter technical conference was to think differently to tackle the challenges ahead.

“Neonicotinoids have been used on UK beet since 1994,” says BBRO lead scientist Dr Mark Stevens. “The current options are Cruiser Force (thiamethoxam+ tefluthrin) or Poncho Beta (clothianidin+ beta-cyfluthrin) and protect crops for up to 14 weeks, depending on the target.”

The three main targets for the neonicotinoid seed treatments are virus-carrying aphids; soil pests — such as wireworm and the soil pest complex; and the first generation of leaf miners.

The soil pest complex is made up of millepedes, symphylids and springtails, all of which cause damage to seedling plants at emergence. A neonicotinoid insecticide alone gives useful control of the soil pest complex but, because the active ingredient is mostly in the beet plant, pests have to attack it to gain a lethal dose. Addition of a pyrethroid gives better protection against high pest populations as many are killed on entering the protection zone around the roots. It also reduces the amount of sub-lethal damage that can weaken beet plants and reduce their yield potential.

“The pyrethroids as stand-alone treatments have some potential to help control the soil pest complex. There are no resistant varieties available so avoid sowing sugar beet after grass to reduce risk of damage,” suggests Mark.

“The current options available to control leaf miner are very limited — with pyrethroid Hallmark Zeon (lambda cyhalothrin) available, but it’s not systemic and has a negative impact on other beneficial insects. In the 2015/2016 season, an emergency approval was granted for Biscaya (thiacloprid) in what was a difficult year for the pest.”

But it’s virus yellows that poses the biggest threat, especially as there are currently no insecticide options registered to control its vector, the peach-potato aphid (*Myzus persicae*) and even if there were, its resistance to pyrethroids

and carbamates would likely be a problem.

“There are no resistant varieties currently available so on-farm crop hygiene will be crucially important in controlling virus yellows. The UK is at the highest risk of the disease in Europe because our maritime climate favours survival of the virus-carrying aphids over the winter,” he explains.

British Sugar virus yellows forecasting for 2017 showed that crops could have potential infection of up to 43.3% for 15 April sowings where no pest control was used, with the lowest risk crops still carrying a 14.5% potential infection. With yield losses of up to 50% possible where infections occur early in the season, virus yellows control is a potential problem BBRO are working very hard to find a solution to.

“We’re improving surveillance and monitoring with real time information on aphid numbers, resistance and virus content to help provide more specific virus forecasts using regional risk analysis. We’re also screening insecticides for their activity on *Myzus persicae* and running field trials to study push-pull and aphid barrier strategies,” says Mark.

But the answer to virus yellows control probably lies with plant breeders, although that’s not without its challenges, he says.

“With three viruses responsible for virus yellows, there’s no single source of major

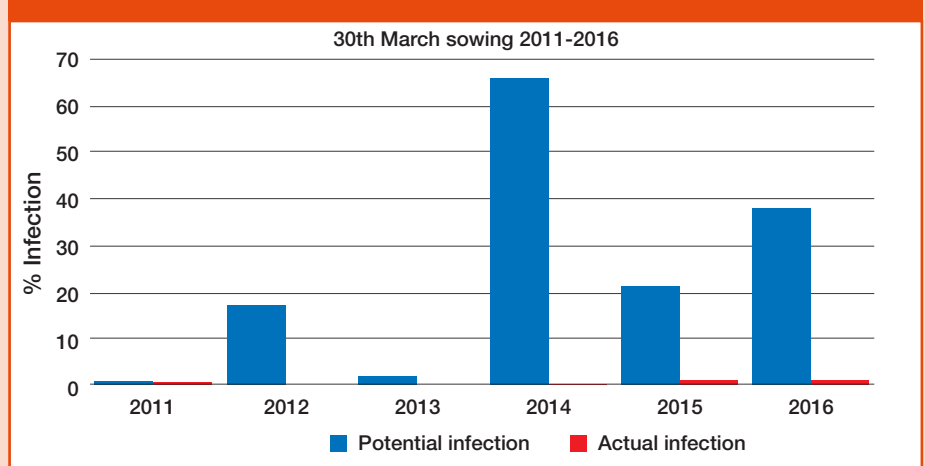


Mark Stevens explains the future options for control of problems such as virus yellows if neonicotinoids disappear from the armoury.

resistance available but breeders are looking to develop resistant/tolerant varieties.”

Other future breeding options include developing the plant’s own resistance to aphids, exploiting existing mature plant resistance by sowing crops early to reach the 12-leaf stage when the mechanism develops and increasing the sugar beet plants own immunity to viruses/insects. Modern breeding technology solutions may help speed up the process, he adds.

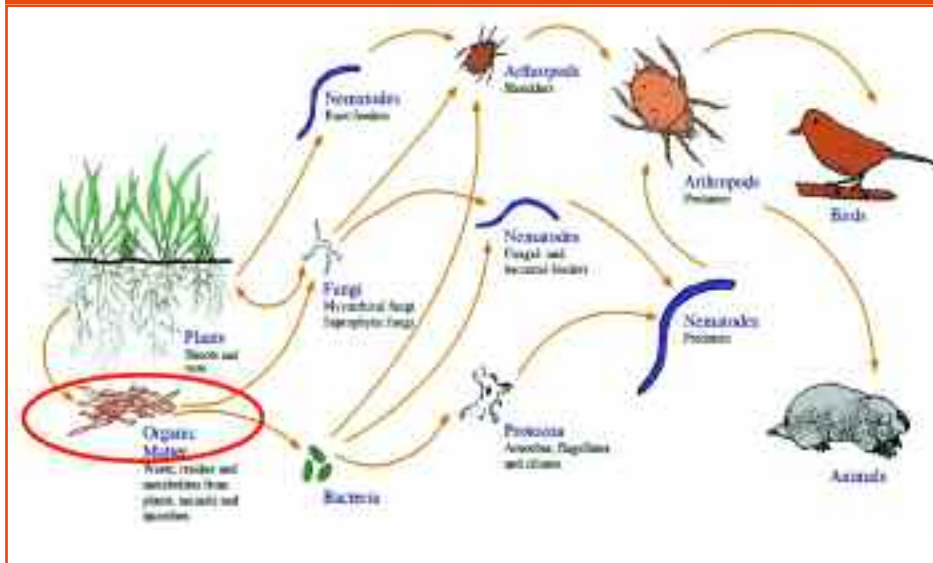
### Potential/actual incidence of Virus Yellows



The chart shows the potential threat from virus yellows remains, even though incidence has been very low due to control by the use of neonicotinoid seed treatments. Source: BBRO

# Sugar beet soils

## Organic matter drives the soil food web



Source: Innovation for Agriculture



Another alternative to adding organic amendments is to grow a cover or catchcrop.

► has been shown in studies to have a bigger impact on the soil biology, he explains.

Another alternative to adding organic amendments is to grow a cover or catch crop. These provide an opportunity to balance your objectives above

ground — such as attracting beneficials, pest control or finishing livestock — with objectives below ground, building soil structure, biology and nutrients.

BBRO is investigating the impact of SOM on sugar beet performance at the BBRO Demonstration Farm, Rougham

Estates in Suffolk. Stephen suggests growers also try things for themselves, engage the BBRO to help and become familiar with the BBRO/AHDB 'Great soils' project.

Stephen sums up by stressing soil health is crucial for productivity, profit and resilience. "SOM matters and more carbon inputs drive soil health," he says. "Feed soil biology by becoming subterranean livestock farmers and utilise compost, bio-solids and cover crops to add carbon. Always measure and monitor trends and let's have less soil talk and more action." ■

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