Feature

By Dr Georgina Barratt
Applied Crop Scientist, BBRO

Considering Carbon — what's it all about?

You can't avoid the discussion and debate about carbon in farming. It dominates discussions and is set to shape how we farm and how we are paid to farm in the future. What does it all mean for sugar beet?

In the first of a series of articles on carbon, Dr Georgina Barratt has been doing some essential background investigative work of the facts and fiction and presents an invaluable overview and a first view of where low carbon sugar beet may be heading?

Target Net Zero – 'the politics'

The landmark Paris climate agreement in 2015, aimed to curb global warming by 1.5°C compared to pre-industrial levels, was signed by 197 countries, including the USA, China and the UK. Since then, greenhouse gas emissions have been near the top of the political agenda with the UK setting a target to be net zero by 2050 and the NFU setting a more ambitious target for agriculture of 2040. In the UK 69% of the land area is used for farming meaning that agriculture clearly has a significant role to play in achieving net zero. How can agriculture help in achieving Net Zero, and how does sugar beet fit in to this aim?

How are greenhouse gas emissions measured?

When reading about net zero and greenhouse gas (GHG) emissions the terminology can quickly get confusing, especially as there are often no standard definitions for many of the terms used, even net zero itself! Generally net zero refers to a point where the GHG emissions are matched by removal of GHG from the atmosphere or reduction of GHG emissions (IPCC, 2018). A standardised approach is used to take account of different GHGs through the use of carbon dioxide equivalents (CO_2e). This is calculated by converting amounts of other gases to the equivalent amount of carbon dioxide (CO_2) with the same global warming potential (GWP). GWP can be assessed over varying lengths of time but 100 years is the most widely adopted and results in a conversion value for Methane (CH_4) of 25 and for Nitrous Oxide (N_2O) of 298 (EPA, 2020). In practice this means that emissions of 1 million metric tonnes of methane and nitrous oxide is equivalent to emissions of 25 and 298 million metric tonnes of carbon dioxide respectively. The need for a universal unit of measurement is important as it enables global comparisons between countries and sectors and can help guide policy to target areas for reduction.

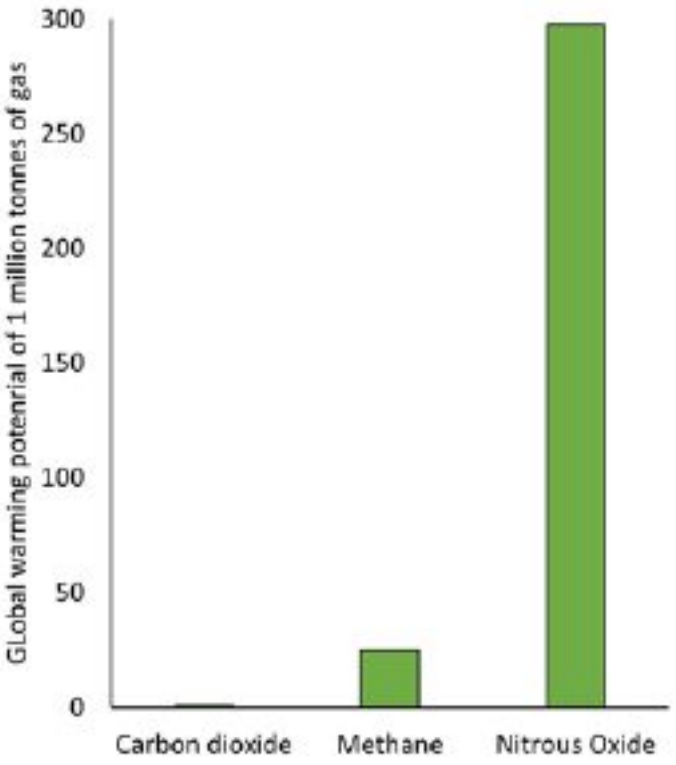

Fig. 2. The global warming potential (GWP) of 1 million tonnes of the three most common greenhouse gases.

Carbon sequestration - Carbon sequestration is the process of capturing and storing atmospheric carbon dioxide. Plants sequester carbon by fixing atmospheric CO_2 through photosynthesis which incorporates carbon into the plant tissues which when returned to the soil becomes part of the soil organic carbon pool (Lal, 2008).

So what do we know?

Emissions from agriculture make up 10% of GHG emissions but are different to other sectors in the UK because CO_2 is not the most emitted gas, instead methane makes up 54% of emissions, nitrous oxide 32% and therefore CO_2 accounts for 14% of the GHG emitted (Department for business, energy and industrial strategy, 2019). Methane is mainly produced by livestock, and nitrous oxide and CO_2 from the use of artificial fertilizers, fossil fuels and emissions from the soil. This means that in arable enterprises, including sugar beet, the main sources of emissions are fuel, fertilizer and soil emissions (The Climate Change Committee, 2017). Soil emissions occur every time the soil is disturbed as this stimulates soil microbe activity which emits GHGs (Oertel et al, 2016). The good news here is that these are all factors which are associated with costs too, but of course reducing or changing them can also affect yield. However, it is likely that more support will be available for carbon friendly farming, maybe even through the ELMS itself, so reducing carbon emissions in arable systems should be financially viable in time.

So what does all that mean on farm?

Just as emissions are calculated at a national scale, emissions can also be calculated on farm using carbon calculators. Despite the title 'carbon calculators' these take in to account the main GHG using CO_2e as previously explained. The three that appear most popular are The Farm Carbon Toolkit, Agrecalc and the Cool Farm Tool. Although they all use slightly different metrics and can give different results they can help you to get an understanding of where your emissions are coming from and also where you are actually capturing and sequestering carbon. The ability of plants to sequester carbon is one of the biggest strengths to agriculture in the pursuit of net zero. This is because many industries have to pay to offset their carbon by buying land, planting trees or investing in expensive carbon capturing technology. To have this ability inhouse means agriculture has the power to become net zero independently. The need for companies to offset carbon, that is to pay for captured carbon to offset that emitted, also means there is a move towards carbon becoming a commodity. This monetisation of carbon is likely to grow and may provide another avenue of income to farm enterprises. As the new Environmental Land Management Scheme (ELMS) is introduced the focus on land and environment is also going to reward many practices that can be seen as more carbon friendly.

Fig. 2. Cultivations release greenhouse gases whilst also using fossil fuels

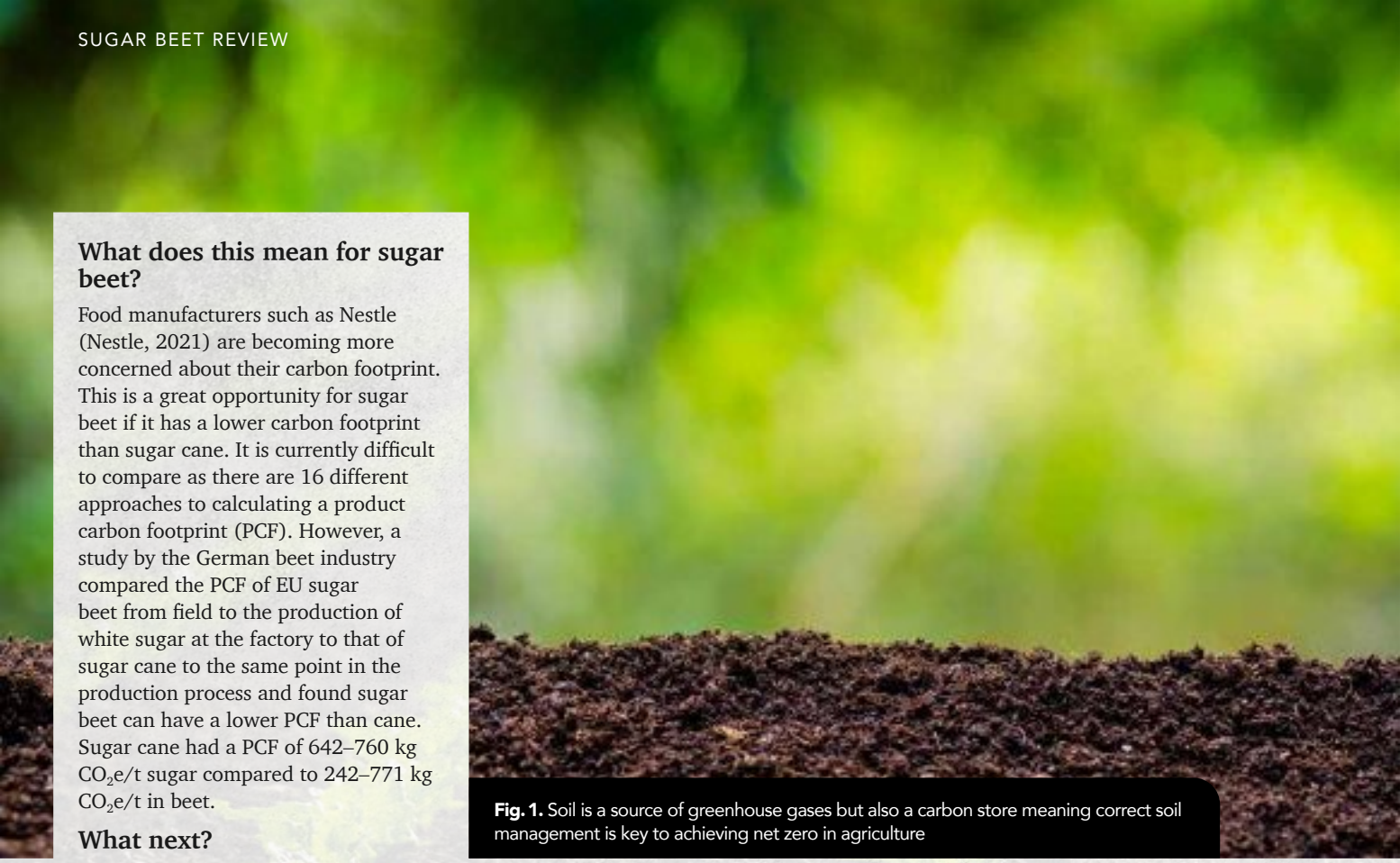

Fig. 1. Soil is a source of greenhouse gases but also a carbon store meaning correct soil management is key to achieving net zero in agriculture

What does this mean for sugar beet?

Food manufacturers such as Nestle (Nestle, 2021) are becoming more concerned about their carbon footprint. This is a great opportunity for sugar beet if it has a lower carbon footprint than sugar cane. It is currently difficult to compare as there are 16 different approaches to calculating a product carbon footprint (PCF). However, a study by the German beet industry compared the PCF of EU sugar beet from field to the production of white sugar at the factory to that of sugar cane to the same point in the production process and found sugar beet can have a lower PCF than cane. Sugar cane had a PCF of 642–760 kg CO_2e/t sugar compared to 242–771 kg CO_2e/t in beet.

What next?

British sugar has been working with the carbon trust to calculate carbon emissions from sugar production using a standardised approach. The emission figures are now being reviewed and it has been identified work is needed to refine the on-farm emissions figure. British Sugar are leading a project to refine these numbers and will also work alongside the NFU and BBRO. In the longer term this research could be used to develop a tool to help assess the carbon impact of management decisions and produce practical on farm advice on alternative options such as strip till, placement fertiliser and cover crops, acknowledging that a one size fits all approach will not work.

BBRO, British Sugar and the NFU will continue to work together to identify and advise sugar beet growers on achieving net zero, so that we can ensure that the sector plays its part in the overall Net Zero aim of agriculture.

Fig. 4. Fertilizer is the biggest source of greenhouse gases in arable systems

References

Department for Business Energy and Industrial Strategy (2021). 2019 UK Greenhouse Gas Emissions, Final Figures. London: Department for Business Energy and Industrial Strategy.

EPA. (2020). Understanding Global Warming Potentials. Available: https://www.epa.gov/ghgemissions/understanding-global-warming-potentials. Last accessed 13th Jul 2021.

IPCC, 2018: Annex I: Glossary [Matthews, J.B.R. (ed.)]. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press.

Lal, R. (2008). Carbon sequestration. Philosophical Transactions of the Royal Society B: Biological Sciences, 363(1492), 815-830.

Nestle. (2021). We commit to net zero by 2050. Available: https://www.nestle.com/csv/global-initiatives/zero-environmental-impact/climate-change-net-zero-roadmap/commitment. Last accessed 13th Jul 2021.

Oertel, C., Matschullat, J., Zurba, K., Zimmermann, F., & Erasmi, S. (2016). Greenhouse gas emissions from soils—A review. Geochemistry, 76(3), 327-352.

The Committee on Climate Change (2017). 2017 Report to Parliament. London: The Committee on Climate Change.