Beeswax Dyson Farming

Our Soils

The most valuable natural asset we have is our soil. It is fundamental to producing the food we eat; it also helps to create the oxygen we breathe and clean the water we drink. Healthy soil can also increase our resilience to climate change by storing carbon and helping to prevent flooding.

Over the past eight years much work has been focused on improving the various aspects of soil health including pH, organic matter and nutrient content. Green Crop Information were asked to complete an assessment to determine the impact of our soil improvement strategy.

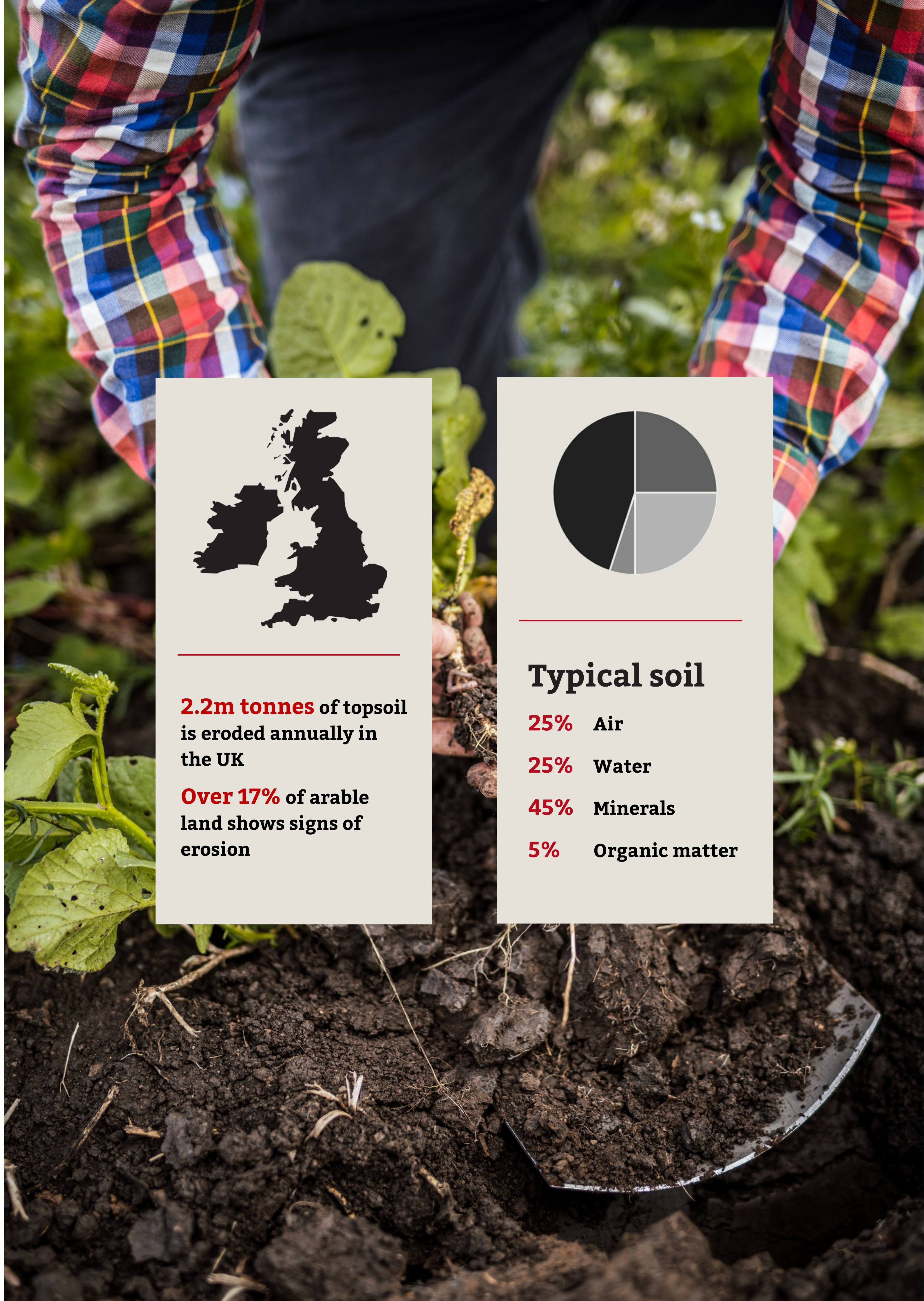
Data collected by a third party from our farm in Stubton, Lincolnshire from 2011 (pre BDFL ownership), 2016 and 2020 was analysed. Soil pH and nutrient contents for potassium (K), phosphorus (P) and magnesium (Mg) were compared across the three datasets.

Soil organic matter

Sufficient soil organic matter (SOM) is vital to good soil and plant health, having many benefits including (but not limited to) improved water infiltration and retention, more resilient soil structure, and greater diversity of microbes, fungi and invertebrates. For this study, SOM was measured by loss on ignition and the laboratory reported uncertainty values of 10 – 18%. Uncertainty occurs from various sources including sampling procedure, sample handling before and during lab work, and inherent variation in the analytical technique. This is true for every analytical value quoted for a soil sample, although the uncertainty value itself depends on the exact situation. In practice, it is useful to understand that an observed change, especially if it is small, may in fact be down to the analysis rather than the sample.

Green Crop Information
A branch of Beeswax Dyson

We believe that the farming industry is stronger when working together, sharing knowledge, experience and information. To help us achieve greater collaboration, Green Crop Information was formed based on the work of Dr Chris Green and the Crop Management Information team – this was already a widely valued source of evidence-backed data and peer reviewed studies. The pursuit of better information, smarter technologies and new ideas is what drives the team onwards.



2.2m tonnes of topsoil is eroded annually in the UK

Over 17% of arable land shows signs of erosion

Typical soil

25%	**Air**
25%	**Water**
45%	**Minerals**
5%	**Organic matter**

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Soil organic matter (continued)

At Stubton, most SOM values showed no effective change, once uncertainty was accounted for (Figure 1), and this was entirely expected due to the short time frame between samples. Measurable organic matter in soil builds up very slowly, because a proportion of the materials added break down rather than staying in the soil. Several scientific studies, reviewing hundreds of long-term field experiments in the UK and Europe, suggest a maximum increase of around 0.1 % SOM per year is possible, when measured over decades. However, it is likely to take up to ten years of annual applications to see a significant, measurable, increase. The breakdown process is itself important, releasing nutrients for plants and providing 'food' for microbes. Therefore, it is very important to keep checking SOM values (using a consistent analytical method, e.g. loss on ignition) every 4 to 5 years for as long as possible. This allows a long-term trend to be determined and will eventually show any changes occurring.

A minority of fields (those with red dots in Figure 1) showed an apparent increase or decrease in SOM. These could have been a result of slightly different sampling locations, different soil management practices, or anomalies occurring in the laboratory. It will be important to continue to monitor these fields, to better understand any genuine trends at these locations.

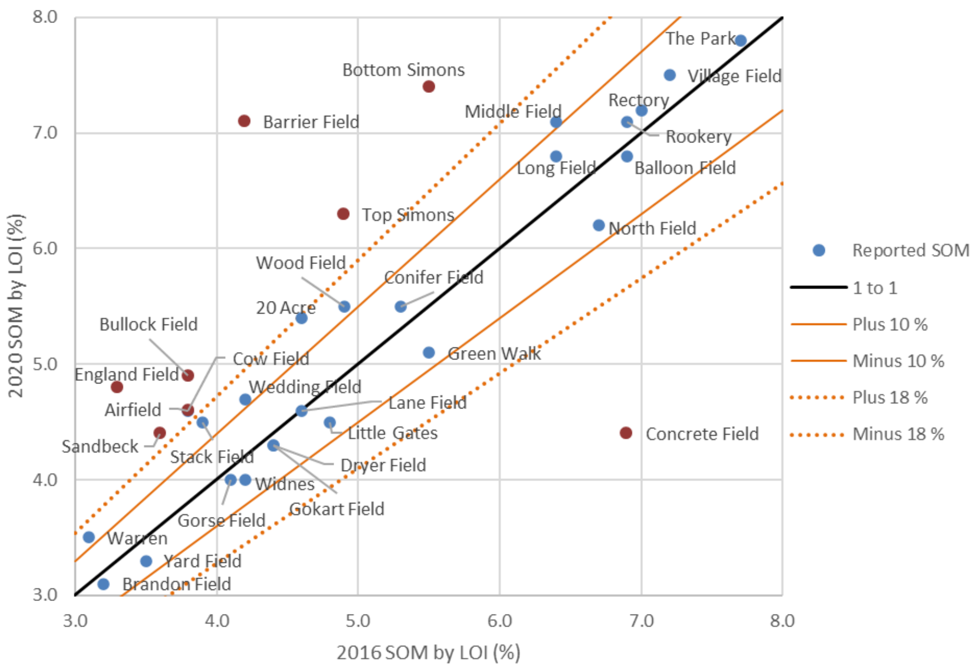

Figure 1. Comparison of soil organic matter (SOM) values from 2016 and 2020, with 10 – 18% confidence intervals shown for reference. Dark red dots show fields outside the 18% uncertainty boundary.

BDFL has applied

570,000t

of organic material to our soils

Equating to a financial investment of

£2.8m

to date

Soil pH and nutrients

On reviewing the soil pH (Figure 2) and nutrient maps (Figure 3) from 2011, BDFL identified several key areas that needed to be addressed to improve crop production and efficiency. The application of manures can be an effective management practice to raise the pH of soils. Cattle, poultry and pig manures as well as liquid digestate were applied across the estate in 2014, 2017 and 2019, respectively. By 2020, the analysis clearly shows that areas of low soil pH had improved from 5.25 to around 6.5. This is particularly evident in fields of the northern block (Figure 2).

Phosphorus (P) content has been improved to an even greater extent under BDFL management, thanks to the use of cover crops, organic amendments and applications of di-ammonium phosphate. In 2013 when Beeswax took on the estate, large areas had a soil P index of 0 to 1. The application of poultry and pig manures had a two-fold benefit in terms of improving P availability: firstly the materials contain P which is released to become available for uptake by crops as the manure breaks down, and secondly the presence of organic matter in soil means that P is less strongly 'locked up' by calcium and therefore remains available for longer. This is particularly an issue in lime-rich soils, such as those at Stubton, where the relatively high concentrations of calcium in combination with pH above 6.5 can considerably reduce P availability.

Potassium index across the estate is strongly influenced by soil type. Soil textures range from clay soils (52% clay) in the north west to free draining and sandy soils (88% sand) in the south east (Figure 4). The high clay content promotes retention of potassium. Addition of mineral fertilisers and organic materials therefore increased the concentration of potassium, and the effect was particularly noticeable in the west of the estate. Overall soil potassium increased from an index of 1 to 2- in 2011 to index 2 to 4+ in 2020.

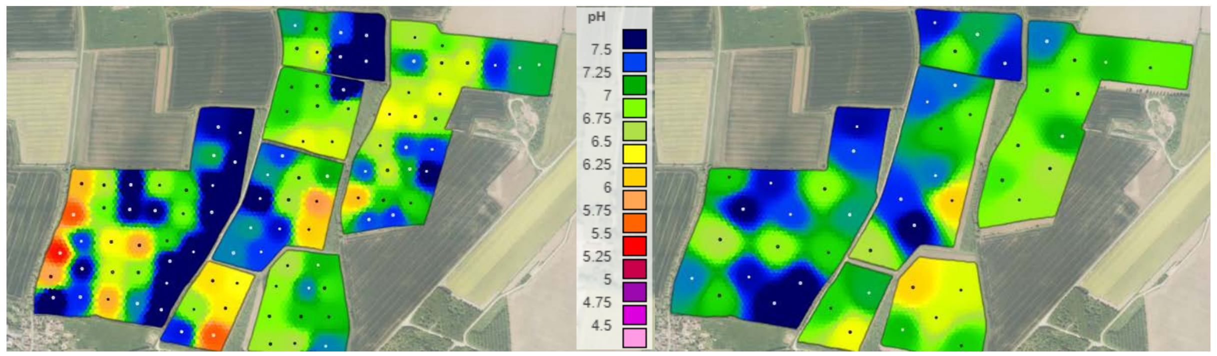

Figure 2. Soil pH as measured in the northern part of Stubton farm in 2011 (left) and 2020 (right).

Figure 3. Soil phosphorus as measured at Stubton in 2011 (left), 2016 (centre) and 2020 (right).

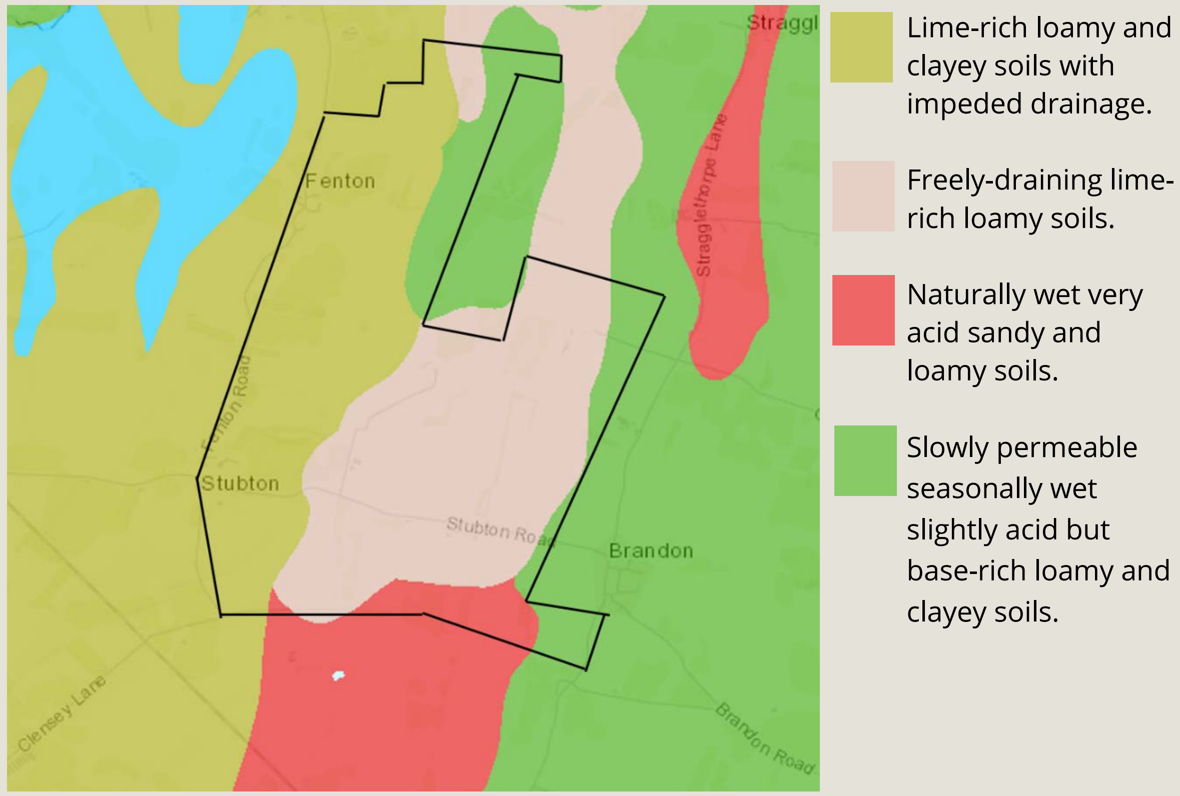

Figure 4. Approximate outline of Stubton farm superimposed on underlying (natural) soil types (see key for soils descriptions). Source: www.landis.org.uk/soilscapes/. Copyright: Cranfield University

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Conclusions

Reviewing soil chemistry measurements has shown that the investment in organic materials (all except AD liquid were sourced externally) has brought about some substantial improvements in our soils at Stubton. Most notably, the soil pH and phosphorus index have improved.

In keeping with the scientific research, widespread changes to SOM have not yet been observed: it is a too short a period in which to expect to measure a change. Going forward BDFL will continue to apply a variety of organic manures and also utilise cover crops with reduced tillage where possible in a rotation that includes potatoes, sugar beet and vining peas. The changes to soil chemistry will continue to be measured on four-year rotation, and selected fields will also undergo physical and biological assessments.

The key learning points from this review are:

- Take soil samples under consistent environmental conditions: similar temperature and soil moisture.
- Long-term trends are important, especially with respect to SOM. It is necessary to continually monitor, using the same sampling protocol and analysis method, for many years.
- Knowing key information about soils across the farm (texture, lime content, natural drainage) can help understand how nutrient profiles are likely to differ and can best be managed.