

# SOIL HEALTH RACE IS MORE LIKE A MARATHON

A unique AHDB project is bringing together growers' experiences and innovative trial results to quantify the impact of soil management decisions across the whole rotation.

In a relay race, athletes train hard to run their stretch of track as fast as possible AND ensure the optimal handover of the baton to the next runner in line. In some respects, soil is a little bit like that baton. All too often, it isn't passed on as smoothly and efficiently as it could be to the next crop, which then stumbles and fails to get off to the best start. Unlike the relay, however, soil management can be a slow, long-term affair – making its success (or failure) a challenge to measure. A decision taken in one cropping year, can resonate long after, causing effects (either positive or negative) in subsequent crops. And whether these effects are detectable depends on many other factors, not least the weather. With recent developments in cropping opportunities and techniques, it's no wonder soil scientists are on a permanent quest to pin down the best approaches to manage soil across the marathon of a whole rotation.

## ROTATIONS RESEARCH PARTNERSHIP

In May 2016, AHDB established the five-year 'Rotations Research Partnership' to take stock of developments in crop management, including precision farming techniques, and quantify how rotational management affects soil physical condition. The work also looks at some of the more challenging rotational crops too – particularly root crops – and how soil conditions affect water uptake, plant growth and development.

The work was commissioned, in part, to find ways to address the levelling off of yield seen in many of the UK's key crops. Defra statistics show wheat yields increased by an average of 0.11t/ha/year between 1960 and 1999, with no significant increase since then. A similar chart for potatoes shows yield increases of 0.65t/ha/year from 1960 to 1996, but no evidence of any significant yield increase after 1996 (Figure 1).

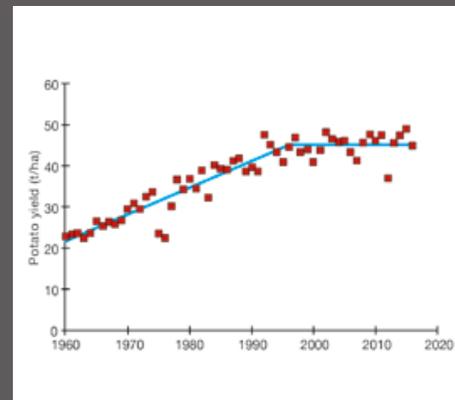


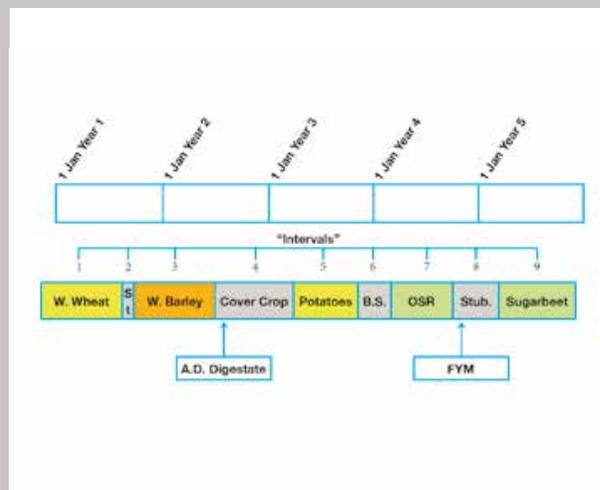
Figure 1. Data from AHDB Potatoes shows potato yields have stagnated since 1996

## GROWERS' EXPERIENCES

AHDB believes in the power of farmer-to-farmer learning, and that many soil management solutions will come directly from farms. As a result, a 'Grower Platform' has been established at the heart of the Partnership. The inclusion of like-minded researchers, farmers, agronomists and businesses allows their experiences to be tapped into, which contributes to the wider dataset being generated by the project.

Members of the Grower Platform have completed a NIAB CUF-led survey designed to identify the 'cause and effect' associated with soil management decisions. Members were asked to break down their rotations into 'intervals', where each interval represented 'a distinct period of land use for at least seven days' (Figure 2). Information on agronomic inputs and costs (eg fertilisers, irrigation, crop residues, organic amendments and field operations) was also collected, alongside information on the impact of management (eg effect on weeds, pests and disease control).

Figure 2. People were asked to declare the composition of their rotations, along with information on the use of key agronomic inputs.



**The survey is being analysed to answer the following questions:**

- Is there an association between the use of soil amendments and agronomic and economic sustainability?
- What cultivation practices are associated with good soil characteristics?
- Is there an association between the types of crops in a rotation and soil health and resilience?
- Is there an economic benefit with having an association with livestock in the rotation?

**LONG-TERM EXPERIMENTS**

The results from the survey process are also being used to help steer the direction of a range of field experiments that are being conducted across the full five-year lifespan of the work. The experiments range from small, highly controlled research experiments to large on-farm crop trials.



MARC ALLISON

NIAB CUF's Marc Allison said: "To take the results from small experiments and scale them up commercially sometimes takes a leap of faith.

"You may be able to show a treatment makes a difference at the small scale but it's difficult to get the data to show it would be economically viable at the commercial scale."

One of the constraints on soil management research is the complexity and variation in fields, rotations and techniques used across the UK. To help make sense of this variation, the Partnership has encouraged growers to set up their own trials.

Marc said: "By having numerous growers farming many different soil types over many years, we can get the replication we need to turn on-farm data into the powerful data required in research."

In 2017, 24 experiments were conducted, including eight on cover crops and seven on organic amendments – including farm yard manure (FYM), chicken and duck manure, and compost) – with other experiments testing wheel track and tyre pressures. The 2018 season will deliver a further 23 experiments. When the project concludes in 2021, the experiments will have generated a quality data set. In particular, it will allow the residual effects of earlier treatments to be analysed in subsequent crops. Such information will provide valuable insights into the relative benefits of cover crops and amendments.

At present, it has not been possible to conduct statistically valid comparisons between the sets of cover crop experiments, organically amended soils and untreated controls. However, relative to the controls, application of an organic amendment increased potato yields by 6.1t/ha and the use of a cover crop increased yield by 0.5t/ha. Use of organic amendments were sometimes also associated with small decreases in ridge bulk density but these effects were small and inconsistent.

To date, the work that compared the extent of soil compaction under tracked or wheeled tractors showed both caused similar amounts of damage. Other results showed that soil damage could be reduced by reducing tractor tyre pressures during seedbed cultivations. In 2017, potato yield maps were obtained from 26 crops. Although the data is still being analysed, in many cases lower-yielding areas were associated with headlands and wheelings.

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## CASE STUDY: ON-FARM COVER CROP TRIALS

Andrew Webster (pictured) works in partnership with wife, Margaret and his sons at the AW and MA Webster farm in Aughton, Lancashire. The farm grows potatoes for the crisping industry and fodder beet, wheat, oats and grass.



ANDREW WEBSTER

A member of the AHDB Grower Platform, Andrew hosted an experiment on cover crops before planting his potato crop in 2017. The cover crop comprised an oat and vetch mix. The results, from this single year, showed potato yields in the 'cover crop' treated fields were slightly higher than the yield in the control fields – 56.4t/ha and 55.7t/ha, respectively. The cover crop treatment also reduced the total number of tubers and resulted in an increase in tuber fresh weight. The lowest cost cover crop was £99/h to establish and gave a yield benefit of 0.7t/ha. Other benefits associated with the cover, such as the speed of work and the diesel used and the effect on subsequent crops, will be investigated later in the project.

### LONG-TERM INVESTMENT

In 1965, the long-term 'Number 2' experiment at Broom's Barn in Suffolk commenced a three-course rotation of sugar beet, spring cereal and winter cereal. The strategic work allowed the effect of various combinations of inorganic nitrogen (N), phosphate (P), potassium (K) and sodium (Na) and FYM to be tested.

Changes to funding meant application of FYM stopped in the autumn of 2011 and the end of experimental cropping in 2012. Thanks to the Partnership, the research at the long-term site has now been reinstated. During its 'downtime' (2013 to 2016) the site was cropped uniformly and received standard applications of inorganic fertiliser.

The new experiment will investigate the combined effect of historic applications of inorganic fertiliser and organic manure with a fresh application of FYM.

The experimental results, so far, show that both historic and fresh applications of FYM increased yield.



### EXTENDED NETWORK

The Partnership is also taking advantage of AHDB's network of Strategic Farms, including the Potatoes Strategic Farms (SPot Farms) – as their experiments also generate quality data for the Rotations Partnership to analyse.

The SPot Farm South West has established a rye, oat and fodder radish mix and is looking at the



timing and method of its destruction, including comparisons of grazed and sprayed with undfoliated (ie left until primary cultivation and sprayed 2 to 3 days prior to cultivation). Results to date suggest the late-defoliated cover crop aided cultivation and increased subsequent yield.

The SPot Farm East has applied a compost amendment on its sandy soils, following winter cereals. Measurements, including potato yields, are being taken to see if the compost improves soil nutrient- and water-holding capacity, structure and infiltration of irrigation water.

The Rotations Partnership also builds on findings and soil physical indicators from AHDB's Soil Platforms for Potatoes project. Led by the James Hutton Institute, the work found carefully managed potato crops – cultivated and harvested when the soil conditions were near to optimal – did not leave a detrimental legacy within the ploughing depth for subsequent crops, although there was some evidence of subsoil compaction.

## ABOUT THE ROTATIONS PARTNERSHIP

The AHDB Rotations Partnership (Full title: Management of rotations, soil structure and water) comprises four distinct projects:



The partnership is led by NIAB CUF, with the other research partners being the James Hutton Institute, Rothamsted Research and Lancaster University, as well as fourteen other partners, including growers, agronomists and industry.

The work is funded by AHDB Cereals & Oilseeds, AHDB Horticulture, and AHDB Potatoes and is part of AHDB's GREATsoils initiative.

[ahdb.org.uk/greatsoils](http://ahdb.org.uk/greatsoils)

