**RRES Press Release 9 February 2024 Maintaining wheat yields possible over many years**

***Review of world’s longest running field experiment underscores its continuing value***

The long-running Broadbalk field experiment at Rothamsted shows that it is possible to maintain or increase yields of wheat over nearly 200 years with either inorganic fertilizers or organic manure, according to a review published in the journal Advances in Agronomy.  However, to achieve this, changes in management to parts of the experiment have been needed to ensure that soil acidity, weeds and diseases are controlled.

“Long-term experiments (LTEs) are a vital source of information for assessing the sustainability of agricultural systems,” said Paul Poulton, the lead author on the paper. “This review clearly demonstrates that headlines suggesting that we have only a limited number of harvests left are not true in a general sense and that even modest inputs of fertilizer and agrochemicals can maintain crop yields.”

The Broadbalk Wheat Experiment started in 1843 and is the oldest continuing LTE in the world. The site is divided into 20 strips. Several of these have had differing treatments of nitrogen (N), phosphorus (P) and potassium (K) applied. One strip has had nothing applied since the experiment began and acts as a control. Adjacent to it is a strip that has had cattle-based farmyard manure added to it since the start. This was originally done as a comparison with chemical applications and predated the organic movement by nearly a century.

In 1968, and later, major modifications were made to the experiment to reflect contemporary innovations in agriculture. These included the introduction of short-straw winter wheat varieties, growing wheat in rotation with other crops, and testing higher rates of N fertilizer (up to 288 kg N per hectare). Other changes included the use of herbicides and other agrochemicals, except on selected sections. Regular liming continued to maintain a neutral soil pH.

The new review reports crop yields and soil changes since 1968 and summarizes other studies including the incidence of weeds, pests and crop diseases, effects of treatments on nitrate and phosphate movement to drainage water, greenhouse gas fluxes, measurements of N and sulphur (S) inputs from the atmosphere, and many other factors.

The change to short-straw wheat varieties led to a doubling of grain yields. On average, yields of continuous wheat tended to increase at N rates up to 240 or 288 kg per hectare while the 1st wheat in rotation after a 2-year break often needed less nitrogen to reach maximum yield. Best yields now exceed 12 tonne per hectare in some years.

However, where manures have been applied for many years or where the largest amounts of nitrogenous fertilizer have been added, the risk of losses of nitrogenous compounds into the drainage system is high. Such an observation was possible as the experiment has a facility to collect drainage water from one section of treatments.

On a soil that had probably been in arable cropping for centuries before the experiment began, soil organic carbon (SOC) is relatively low at around 1%. Adding manures for many years to some plots increased stocks of carbon by about threefold.

Increasing amounts of nitrogen fertilizer resulted in larger crops and more stubble. Roots were  ploughed-in, leading to increases in soil carbon. Soil organic matter in some treatments has been in equilibrium for many years.

“The experiment and the data from it, together with the archive of crop and soil samples, continue to provide scientists with a valuable resource to increase our fundamental understanding of agricultural systems as well as providing a sound basis for practical management strategies for improving sustainability,” said Poulton.

Publication

[Advances in Agronomy](https://www.sciencedirect.com/bookseries/advances-in-agronomy)

[Volume 184](https://www.sciencedirect.com/bookseries/advances-in-agronomy/vol/184/suppl/C), 2024, Pages 173-298

Chapter Four - The Broadbalk Wheat Experiment, Rothamsted, UK: Crop yields and soil changes during the last 50 years

Author links open overlay panelPaul R. Poulton a, A. Edward Johnston a, Margaret J. Glendining b, Rodger P. White b, Andrew S. Gregory c, Suzanne J. Clark b, Wendy S. Wilmer a, Andy J. Macdonald d, David S. Powlson a