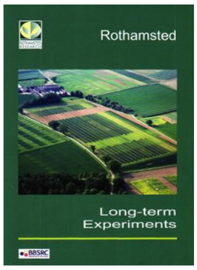
ROTHAMSTED RESEARCH

The Long Term Experiments

Full Table of Content



Meteorological Data

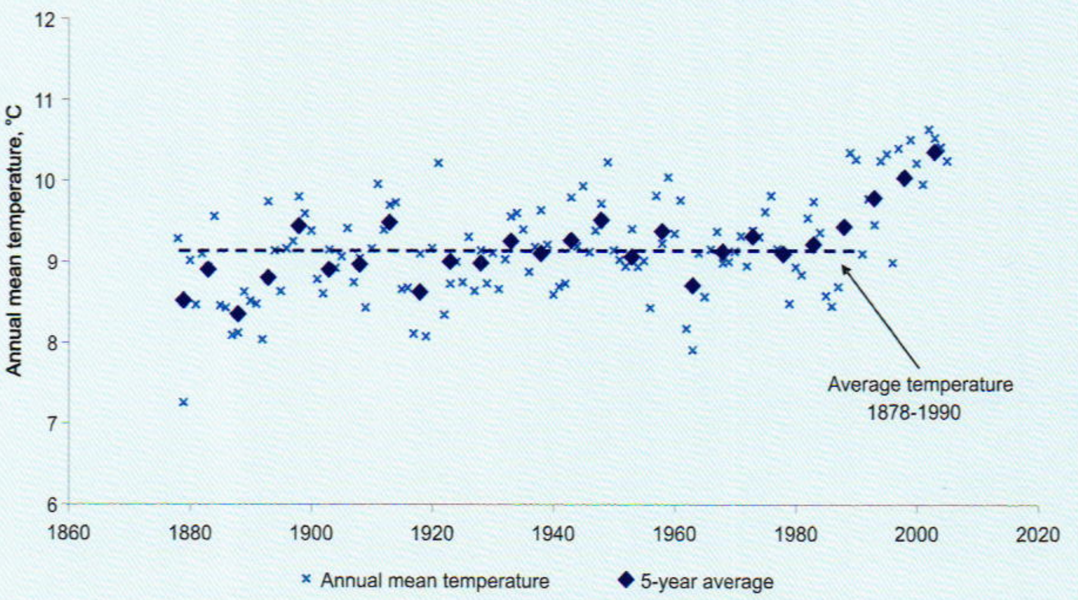
Rothamsted Research

Rothamsted Research (2006) *Meteorological Data ;* The Long Term Experiments, pp 44 - 45 **- DOI: https://doi.org/10.23637/ROTHAMSTED-LONG-TERM-EXPERIMENTS-GUIDE-2006**

METEOROLOGICAL DATA

Concerns over the impact of climate change makes it increasingly important that, when interpreting data from long-term experiments, changes in temperature, rainfall, rainfall patterns, chemical inputs in rainfall and as dry deposition *etc*., are all taken into account. Total rainfall has been measured at Rothamsted since 1853, temperature since 1873; other meteorological data have been collected subsequently. Annual rainfall averages 704mm (mean 1971-2000) but ranges widely from 380mm in 1921 to 973mm in 2000. Increases in temperature in many parts of the world are well documented. At Rothamsted, average annual temperature is now more than 1°C higher than the 1878-1990 average (Fig. 10). Much of that rise is accounted for by increases during the autumn and winter months. At Rothamsted, the 10 warmest years on record occurred in the last 17 years. Average soil temperatures have also risen.

Fig. 10 Annual mean temperature at Rothamsted



Since the 1850s, inputs in rain have changed considerably. Inputs of acidity (H^+ ions) are small; less than 0.1 kg $ha^{-1}yr^{-1}$ up to the 1950s, they reached a maximum of 0.4 kg $ha^{-1}yr^{-1}$ in the 1970s and are now about 0.2 kg $ha^{-1}yr^{-1}$. In contrast, other inputs, such as sulphate, nitrate or ammonium can be much larger. Inputs of sulphate-S were about 5 kg $ha^{-1}yr^{-1}$ in the 1850s, reached a maximum of 65 kg $ha^{-1}yr^{-1}$ by 1980 and, after a dramatic decline, associated with decreasing emissions from power stations and a decline in heavy industry, are now about 5 kg $ha^{-1}yr^{-1}$. Inputs of nitrate- and ammonium-N in rainfall were 1 and 3 kg $ha^{-1}yr^{-1}$, respectively, in 1855, and increased to 8 and 10 kg $ha^{-1}yr^{-1}$ in 1980; since then they have declined to 5 and

https://doi.org/10.23637/ROTHAMSTED-LONG-TERM-EXPERIMENTS-GUIDE-2006

3 kg $ha^{-1}yr^{-1}$, respectively. Estimates of N in dry deposition are available for the last 20 years. In 1996, it amounted to 34 kg N $ha^{-1}yr^{-1}$; about three times that in rainfall. The total input, for wet and dry deposition, of 43 kg N $ha^{-1}yr^{-1}$ agrees well with other estimates; calculated total inputs ranged from 30-50 kg N $ha^{-1}yr^{-1}$ during the late 20th century. We estimate that, in the mid-1850s, total N inputs were about 10 kg $ha^{-1}yr^{-1}$.

Concentrations of carbon dioxide (CO_2) are not measured at Rothamsted but the rise in atmospheric CO_2 concentrations worldwide has been well documented; increasing from about 280 ppm in 1850 to *c*.380 ppm in 2005.

LONG-TERM EXPERIMENTS AS A RESOURCE

Maintaining soil quality and fertility is of worldwide importance; any changes in the factors influencing soil quality and soil processes can take decades to have any measurable effect. Similarly, the effects of agriculture on the wider environment may take years to become obvious. Long-term experiments with their contrasting treatments and management are an invaluable resource, which we can use to examine these effects in greater detail.

Thus, Broadbalk, Hoosfield and Park Grass have been used for detailed work on N cycling in our temperate climate using the stable isotope, ^{15}N, applied to microplots within each experiment. Results show that, on average *c*.50% of the applied fertiliser N was recovered by the crop, 25% remained, as organic N, in the soil and 25% was not accounted for. Most of the nitrate present in the soil profile in the autumn, and therefore at risk of loss by leaching, was derived from SOM, not from unused fertiliser N. Exceptions are where excessive amounts of N have been applied, in relation to potential crop yield, or where the crop has failed. On Park Grass labelled N, as either $^{15}NH_4$ or $^{15}NO_3$, was applied in 1980 and 1981. After 18/19 years, 67% of the $^{15}NH_4$-N had been removed in successive grass harvests (mostly in the first year) but a further 17% still remained, in organic forms, in the soil. Less of the $^{15}NO_3$-N could be accounted for; 60% in the herbage plus 14% in the soil. Labelled N has also been used to assess losses of N by denitrification and leaching, and to measure gross N mineralisation.

Other work has focussed on the soil's ability to act as a sink for methane (CH_4), an important greenhouse gas. For example, on the arable plots on Broadbalk, less CH_4 was oxidised in the soil where fertiliser N had been applied, compared with soil receiving FYM or the control soil receiving neither fertiliser nor manure. In the adjacent woodland (Broadbalk Wilderness) the rate at which CH_4 was taken up was 6 times faster than on the FYM soil. However, in the acid soil of the Geescroft Wilderness there was no CH_4 uptake. Similarly, on Park Grass, CH_4 oxidation was inhibited on soils with a pH of *c*.5 or less.

https://doi.org/10.23637/ROTHAMSTED-LONG-TERM-EXPERIMENTS-GUIDE-2006