



Broadbalk is an agricultural field experiment at Rothamsted Research in Harpenden. It was set up by Sir John Lawes and Sir Joseph Henry Gilbert in 1843 to compare the effect of different fertiliser treatments on wheat yield.

This experiment is still running today, making it one of the oldest, continuous, agricultural experiments in the world. Careful changes have been introduced over time, allowing us to ask new questions that are relevant to modern agricultural practices.



Data collected from Broadbalk (and our other long-term experiments), along with meteorological records and accompanying documents are all available in the [electronic Rothamsted Archive \(e-RA\)](#).

This activity gets students plotting graphs and interrogating real wheat yield data from Broadbalk. It looks at the effect of different fertiliser treatments and farming practices and encourages students to think about why long-term data is important.

## Activity

1. Split the students into two groups. Give one group the Continuous Wheat Data and the other group the Rotational Wheat Data.
2. Students should study the data and plot a bar graph showing the wheat yield in each year for each treatment.
3. To help compare treatments students should calculate the average wheat yield for each treatment and plot those results too.
4. Bring both groups together to share and discuss their findings.

The accompanying slide deck may help to drive discussions.

### Wheat Yield

The amount of wheat grain harvested. It is measured in Tonnes per Hectare (t/ha).

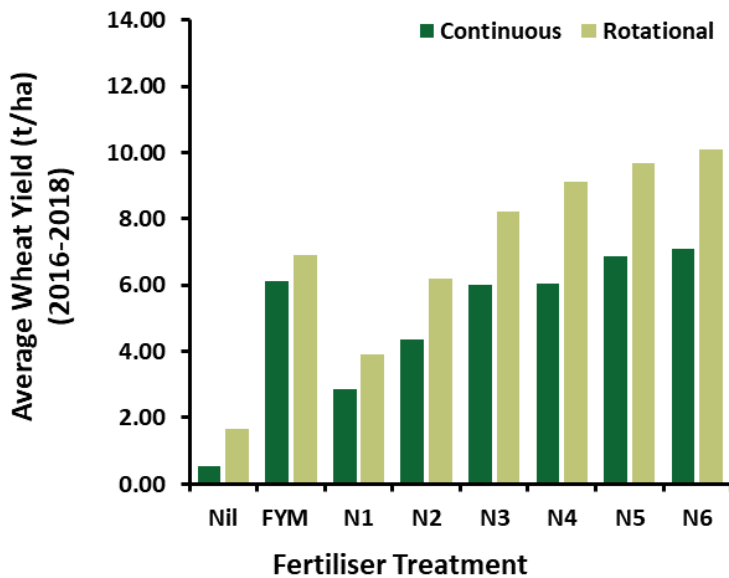
### Continuous Wheat

Wheat is grown every year.

### Rotational Wheat

Wheat is grown for three years, then different crops are grown for two years before returning to wheat and starting the cycle again the following year. The data used here is from wheat grown in the first year, before pests and disease start to creep back in.

## Data



N1 to N6 are inorganic fertilisers that contain increasing levels of Nitrogen (N) and equal levels of Potassium (K), Phosphorus (P) and Magnesium (Mg).

Farm Yard Manure (FYM) is an organic fertiliser, meaning that by using it farmers are not adding inorganic chemicals to their fields. However, supplies of FYM are limited.

## Discussion Points

- How does FYM compare to the N fertilisers?
- How do increasing N levels affect wheat yield?
- Which growing method gave highest yields (continuous or rotational?) and why do you think that might be?
- What other factors might be affecting these results?
- Does any of the data seem anomalous?
- Why are long term experiments like Broadbalk important?

## Conclusions

FYM is a good fertiliser and gives higher yields than no fertiliser or low rates of N fertiliser.

Higher rates of N don't always give greater yields. Mid amounts of fertiliser are best.

Growing wheat in rotation improves yields due to a number of factors deterring pests, reducing diseases, replenishing soil nutrients and increasing soil stability.

The weather can affect results. Fertiliser losses are greatest if the month after application is warm and wet.

Long term experiments allow scientists to see overall trends that are not skewed by anomalies (such as very hot or dry summers). They can also study rotational crop data over several cycles, giving more robust results.



## Continuous Wheat Data

*Wheat is grown every year.*

Fertiliser Treatment	Yield (t/ha) 2016	Yield (t/ha) 2017	Yield (t/ha) 2018	Average Yield (t/ha)
Nil	0.74	0.44	0.44	
FYM	5.65	6.37	6.36	
N1	2.59	3.43	2.56	
N2	4.48	4.03	4.59	
N3	6.7	4.96	6.38	
N4	7.16	3.96	6.98	
N5	9.67	4.39	6.49	
N6	9.63	4.26	7.38	

Nil is the control plot which did not receive any fertiliser.

Farmyard Manure is an organic fertiliser, but supplies are limited.

N1 to N6 are chemical fertilisers containing Nitrogen (N), Phosphorus (P), Potassium (K), Magnesium (Mg).

N1 contains the lowest amount of N.  
N6 contains the highest amount of N.  
They contain the same amount of P, K & Mg.



## Rotational Wheat Data

*Wheat is grown in rotation with other crops. This data comes from the first wheat year in the rotation.*

Fertiliser Treatment	Yield (t/ha) 2016	Yield (t/ha) 2017	Yield (t/ha) 2018	Average Yield (t/ha)
Nil	1.75	2.27	0.95	
FYM	6.45	7.1	7.16	
N1	4.94	4.29	2.55	
N2	7.71	6.53	4.34	
N3	9.31	8.09	7.2	
N4	10.2	9.06	8.14	
N5	11.09	9.82	8.08	
N6	11.66	10.41	8.16	

Nil is the control plot which did not receive any fertiliser.

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