

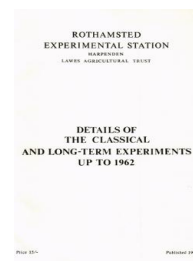
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## Details of the Classical and Long-term Experiments Up to 1962

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### Three- Course Rotation- Rothamsted

#### Rothamsted Research

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THREE-COURSE ROTATION EXPERIMENT  
EFFECTS OF STRAW AND STRAW COMPOST  
LONG HOOS VI, 1933 - 1958

This experiment falls into two periods (i) the original experiment 1933-1951 (ii) modified treatments to test particular points arising from the results of the original experiments 1952-1958. The object of the experiment was to study the long-period effect of raw straw ploughed in and of straw made into compost.

First Period

The rotation was potatoes (Ally till 1941, then Majestic), barley (Plumage Archer), sugar beet (Kuhn till 1941, then Kleinwanzleben E).

There were three series, one for each crop of the rotation. The treatments were:-

- (I) No organic manure, fertilisers applied in spring (F)
- (II) Straw compost applied in autumn (C)
- (III) Raw straw in autumn, fertilisers in spring (Ss)
- (IV) Raw straw in autumn,  $\frac{1}{2}$  fertilisers in autumn,  $\frac{1}{2}$  in spring (Sd)

These treatments were repeated on their respective plots in alternate years to show direct effects plus the cumulative effect of previous dressings and first year residuals. Half the plots received the manures in even years, half in odd years.

Notes 1. From 1933-1937 there was a test of autumn-sown green manuring crops, 0 v. Rye v. Vetches taken factorially with the above, making 24 treatments per series (randomised as one block).

- 2. From 1943 till 1951 sulphate of magnesia was applied yearly to two of the six plots assigned to each main treatment, the dressings being cumulative.

The rates of dressing per acre were:-

- F Fertilisers only 0.4 cwt. N, 0.4 cwt.  $P_2O_5$ , 0.5 cwt.  $K_2O$
- C Straw compost derived from the rotting of  $53\frac{1}{3}$  cwt. straw, the chemical added in the heap providing 0.4 cwt. N and 0.4 cwt.  $P_2O_5$ . In addition 0.5 cwt.  $K_2O$  was applied with the compost.
- Ss  $53\frac{1}{3}$  cwt. straw; 0.4 cwt. N, 0.4 cwt.  $P_2O_5$ , 0.5 cwt.  $K_2O$ .
- Sd  $53\frac{1}{3}$  cwt. straw; 0.2 cwt. N, 0.2 cwt.  $P_2O_5$ , 0.25 cwt.  $K_2O$  in autumn and the same amount of fertiliser again in spring.

Basal dressings: Sugar beet; 0.2 cwt. N, 0.2 cwt.  $P_2O_5$ , 0.25cwt.  $K_2O$ .

Potatoes; 0.4 cwt. N, 0.4 cwt.  $P_2O_5$ , 0.5 cwt.  $K_2O$ .

Barley; None

Fertilisers used: N: Barley and potatoes and autumn  $\frac{1}{2}$  dressing to sugar beet as sulphate of ammonia, sugar beet spring dressing nitrate of soda.

### THREE COURSE

$P_2O_5$ : All crops as superphosphate

$K_2O$ : Barley, sugar beet and autumn  $\frac{1}{2}$  dressing to potatoes as muriate of potash (until 1946 the spring dressing to potatoes was applied as sulphate of potash, afterwards as muriate).

Sulphate of magnesia: All crops 2.5 cwt. per acre.

Application of manures:- Straw and compost with their accompanying fertilisers ploughed in in autumn. Fertilisers for sugar beet and barley harrowed into the seedbed in spring before sowing seed. Fertilisers for potatoes broadcast down the ridges before planting (except in 1951 when they were broadcast before ridging).

Plot area: 0.02 acres.

Second Period: 1952-1958 when the experiment ended.

The experiment was redesigned to ascertain whether the effect of straw could be explained mainly in terms of its power to immobilise nitrogen and to supply potash. The rotation was unchanged and continued on the three blocks, the compost and magnesium sulphate treatments being stopped. The plots formerly receiving only inorganic fertilisers now tested ammonium sulphate ( $N_2$ ) applied in alternate years. One third of the plots originally receiving straw or compost continued to receive straw (S) in alternate years. The remainder tested in presence and absence of sulphate of ammonia the effect of muriate of potash ( $K_S$ ) equivalent to the potash contained in the straw application.

In the original experiment the straw received nitrogen in the form of sulphate of ammonia at the conventional rate ( $N = 0.7\%$  of the dry straw) but in the new experiment nitrogen was tested at 0.2 and 0.6 cwt. per acre, roughly 0.4% of the dry straw ( $N_1$ ) and 1.2% of the dry straw ( $N_2$ ). The straw plots having the lower rate of nitrogen received 0.4 cwt. N ( $N_2$ ) in the following year. No further nitrogen was given in the second year to the straw plots receiving high level of nitrogen, except the appropriate basal dressing.

All plots were split to test additional muriate of potash (K) supplying 0.5 cwt.  $K_2O$  per acre. These potash dressings were not cumulative but alternated on the half plots. The half plots were weighed in the potato crop only.

For each of the three crops there were available

- (a) 6 main plots of the former F treatments, 3 in each phase, i. e. 3 where the fertilisers had been applied in even years and the remaining 3 where the fertilisers had been given in odd years.
- (b) 12 main plots of the former Ss and Sd treatments, 6 in each phase.
- (c) 6 main plots of the former C treatment, 3 in each phase.

Using the symbols given above the treatments were as follows:-

Old system 1933-51

		F			Ss and Sd					C			
		in even years			in even years					in even years			
New	Even years	$N_2$	0	$N_2$	$SN_1$	$SN_3$	$N_2$	0	$K_S N_2$	$K_S$	$SN_3$	$N_2$	$K_S N_2$
System	Odd years	0	$N_2$	0	$N_2$	0	0	$N_2$	0	$N_2$	0	0	0

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For plots which received treatment manures in odd years of the old system the two rows of symbols are interchanged, odd for even and vice versa.

The basal dressings were:

	cwt per acre		
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
Barley	-	0.2	-
Sugar Beet	0.2	0.4	0.25
Potatoes	0.4	0.6	0.5

The fertilisers used were sulphate of ammonia, superphosphate and muriate of potash. Straw was applied in the winter and ploughed in. All fertilisers were applied in spring including the potash equivalent of the straw. Potato fertilisers were broadcast on the flat and the potatoes planted by machine. Ground chalk providing approximately 10 cwt. CaO per acre was applied for the barley in 1952 and 1955-57.

For further information see:-

- Rep. Rothamst. exp. Sta. for 1933, 118-119, Original design, procedure and treatments.
- Rep. Rothamst. exp. Sta. for 1951, 135-140, Summary of 18 years results.
- Results of Field Experiments, 1952, p. Ba/1.1, Details of the revised scheme.
- Rep. Rothamst. exp. Sta. for 1958, 167-171, Summary of 6 years results under the revised scheme.
- Patterson, H. D. An experiment on the effects of straw ploughed in or composted on a three-course rotation of crops. *J. agric. Sci.* (1960) 54, 222-230. Summary of the whole experiment.

Table 24  
Three-Course Rotation Experiment Long Hoos VI  
means over 18 years 1934-51.

Treatment									
Applied to test crop				Applied to previous crop					
F	Ss	Sd	C	F	Ss	Sd	C	S.E.	
<u>Potatoes, total tubers: tons per acre</u>									
9.12	9.64	9.25	8.00	6.99	8.02	8.11	7.58	±0.137	
<u>Barley, grain: cwt per acre</u>									
32.3	30.8	30.8	27.5	27.4	27.3	28.0	26.3	±0.55	
<u>Sugar beet, total sugar: cwt per acre</u>									
43.3	41.0	40.9	36.9	37.3	37.4	38.6	36.1	±0.68	

THREE COURSE

THREE-COURSE ROTATION EXPERIMENT, LONG HOOS VI  
means over 6 years 1953-58

Table 25

Treatments to		Potatoes, total tubers: tons per acre					
		Original treatment (1933-51)					
Potatoes		Straw		Compost		Fertilizers only	
		N to potatoes: cwt per acre					
Preceding sugar beet		0.4	0.8	0.4	0.8	0.4	0.8
S+0.2 cwt. N/acre	-	8.20	9.68	-	8.85	-	-
-	S+0.2 cwt. N/acre	8.37	9.53	8.15	-	-	-
K <sub>8</sub>	-	8.01	9.66	-	9.64	-	-
-	K <sub>8</sub>	8.28	9.43	8.18	-	-	-
-	-	7.67	8.87	7.54	8.79	7.24	8.50
Mean		8.03	9.34	7.96	9.09	7.24	8.50

Table 26

Treatments to		Barley, grain: cwt per acre					
		Original treatment (1933-51)					
Barley		Straw		Compost		Fertilizers only	
		N to barley: cwt per acre					
Preceding potatoes		0.0	0.4	0.0	0.4	0.0	0.4
S+0.2 cwt. N/acre	-	26.3	31.2	-	31.2	-	-
-	S+0.2 cwt. N/acre	28.2	31.0	29.0	-	-	-
K <sub>8</sub>	-	27.7	31.9	-	30.6	-	-
-	K <sub>8</sub>	27.4	32.0	27.4	-	-	-
-	-	27.2	30.8	29.4	31.7	27.8	31.1
Mean		27.3	31.3	28.6	31.2	27.8	31.1

Table 27

Treatments to		Sugar beet, total sugar: cwt per acre					
		Original treatment (1933-51)					
Sugar beet		Straw		Compost		Fertilizers only	
		N to sugar beet : cwt per acre					
Preceding barley		0.2	0.6	0.2	0.6	0.2	0.6
S+0.2 cwt. N/acre	-	35.7	42.2	-	41.2	-	-
-	S+0.2 cwt. N/acre	37.0	44.0	34.6	-	-	-
K <sub>8</sub>	-	37.6	43.4	-	41.0	-	-
-	K <sub>8</sub>	36.9	41.6	37.8	-	-	-
-	-	35.9	42.5	34.4	43.0	34.4	41.7
Mean		36.5	42.7	35.6	41.7	34.4	41.7