

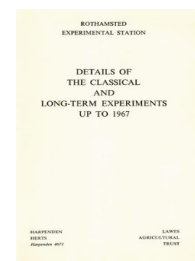
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## Details of the Classical and Long-term Experiments Up to 1967

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### Three-course Rotation - Rothamsted

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### THREE-COURSE ROTATION EXPERIMENT EFFECTS OF STRAW AND STRAW COMPOST, LONG HOOS VI, 1933-58

This experiment falls into two periods: (i) the original experiment, 1933-51; (ii) modified treatments to test particular points arising from the results of the original experiments, 1952-58. 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, 1933-51

**Rotation and treatments.** 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 fortified with fertilisers applied in autumn (C)
- (iii) Raw straw in autumn, fertilisers in spring (Ss)
- (iv) Raw straw in autumn, half fertilisers in autumn, half 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 to 1937 there was a test of autumn-sown green manuring crops, O v. Rye v. Vetches taken factorially with the above, making 24 treatments per series (randomised as one block).

2. From 1943 to 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  $P_2O_5$ , 0.25 cwt  $K_2O$ .  
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 half dressing to sugar beet as sulphate of ammonia; sugar beet spring dressing nitrate of

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soda;  $P_2O_5$ : all crops as superphosphate;  $K_2O$ : barley, sugar beet and autumn half 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.

**Application of manures.** Straw and compost with their accompanying fertilisers ploughed down 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).

**Size of plots:** 0.02 acre.

#### Second period: 1952–58 when the experiment ended

**Rotation and treatments.** 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 sulphate of magnesia treatments being stopped. The plots formerly receiving only inorganic fertilisers now tested sulphate of ammonia ( $N_2$ ) 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 ( $N_1$ ), ( $N_3$ ). 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  $K_2O$ . 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) Six main plots of the former F treatments, three in each phase, i.e. three where the fertilisers had been applied in even years and the remaining three where the fertilisers had been given in odd years
- (b) Twelve main plots of the former Ss and Sd treatments, six in each phase
- (c) Six main plots of the former C treatment, three in each phase.

Using the symbols given above the treatments were as follows:

E—D.E.

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		Old system 1933-51											
		F				Ss and Sd				C			
		in even years				in even years				in even years			
New system	—Even years	N2	0	N2	SN1	SN3	N2	0	K <sub>s</sub> N2	K <sub>s</sub>	SN3	N2	K <sub>s</sub> N2
	—Odd years	0	N2	0	N2	0	0	N2	0	N2	0	0	0

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*.

#### Basal dressings

	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 was applied for the barley in 1952 and 1955-57.

#### References

- Original design, procedure and treatments. *Rep. Rothamsted exp. Stn for 1933*, 118-119.  
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**TABLE 27**  
*Three-course rotation experiment, Long Hoos VI*  
 Means over 18 years 1934-51

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

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TABLE 28

*Three-course rotation experiment, Long Hoos VI*  
Means over 6 years, 1953-58: original treatment, 1933-51

Treatments to:		Original treatment (1933-51)					
Potatoes	Preceding sugar beet	Straw		Compost N to potatoes: cwt		Fertilisers only	
		0.4	0.8	0.4	0.8	0.4	0.8
S+0.2 cwt N	—	8.20	9.68	—	8.85	—	—
—	S+0.2 cwt N	8.37	9.53	8.15	—	—	—
K <sub>s</sub>	—	8.01	9.66	—	9.64	—	—
—	K <sub>s</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

Treatments to:		Original treatment (1933-51)					
Barley	Preceding potatoes	Straw		Compost N to barley: cwt		Fertilisers only	
		0.0	0.4	0.0	0.4	0.0	0.4
S+0.2 cwt N	—	26.3	31.2	—	31.2	—	—
—	S+0.2 cwt N	28.2	31.0	29.0	—	—	—
K <sub>s</sub>	—	27.7	31.9	—	30.6	—	—
—	K <sub>s</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

Treatments to:		Original treatment (1933-51)					
Sugar beet	Preceding barley	Straw		Compost N to sugar beet: cwt		Fertilisers only	
		0.2	0.6	0.2	0.6	0.2	0.6
S+0.2 cwt N	—	35.7	42.2	—	41.2	—	—
—	S+0.2 cwt N	37.0	44.0	34.6	—	—	—
K <sub>s</sub>	—	37.6	43.4	—	41.0	—	—
—	K <sub>s</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