

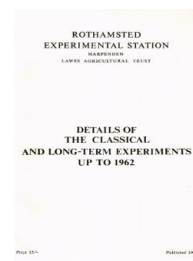
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## Details of the Classical and Long-term Experiments Up to 1962

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### Four-course Rotation- Rothamsted

#### Rothamsted Research

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FOUR-COURSE ROTATION EXPERIMENT  
RESIDUAL VALUES OF ORGANIC MANURES AND PHOSPHATIC  
FERTILISERS, HOOSFIELD, 1930-1956.

This experiment falls into two periods: 1930-1954 the original scheme which attained full cycle in the crops of 1934; and 1955-1956 when a modified scheme was in operation.

1. The Original Experiment. 1930-1954.

The five treatments were farmyard manure, straw compost, straw, superphosphate and rock phosphate (Gafsa); the cropping followed a 4-course rotation (potatoes, barley, ryegrass, wheat). There were four series, one for each crop of the rotation. Each series had twenty-five plots.

Farmyard manure and straw compost were each applied at a rate to supply 50 cwt. of organic matter per acre. The quantity of raw straw per acre for ploughing in was such that if rotted in the heap it would produce compost containing 50 cwt. of organic matter. The nutrient content of the three organic treatments was equalised by adding sulphate of ammonia, muriate of potash and superphosphate, to raise the totals to 1.8 cwt. N, 1.2 cwt.  $P_2O_5$  and 3.0 cwts.  $K_2O$  per acre. The phosphatic fertilisers were applied at the rate of 1.2 cwt.  $P_2O_5$  per acre, together with sulphate of ammonia and muriate of potash at the above rates.

Any given plot always received the same treatment, but the treatment was applied to the plot only once in five years, except that the sulphate of ammonia and muriate of potash on the phosphatic plots were applied annually at one fifth of the full rates. Thus in each of the 4 crops every manurial treatment had a set of 5 plots showing respectively its 5 stages of exhaustion. The full cycle was therefore 20 years.

Plot area: 0.0244 acre (Series IV 0.0233).

The fertilisers were applied as follows:-

Bulky organic manures ploughed in before sowing wheat and autumn-sown ryegrass, and later in the winter for the barley and potatoes. Supplementary fertilisers for farmyard manure and compost applied and ploughed down with these organics, the supplementary nitrogen for the straw was applied in three successive dressings. The straw was chaffed to enable it to be ploughed in properly. Superphosphate and rock phosphate with their accompanying potash and half their nitrogen were applied in the seedbed for autumn-sown crops leaving the remaining half of their nitrogen for a spring top dressing. For barley and potatoes the superphosphate and rock phosphate with their supplementary potash and nitrogen were given in the seedbed and ridges respectively.

The following changes have been made:-

- 1930-31 Turnips were grown but these gave place to potatoes in 1932 and subsequently.  
1935 Undersown clover-ryegrass ley replaced by Western Wolths ryegrass sown in autumn.

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- 1942 Variety of potatoes changed from Ally to Majestic and potato plots split to test an extra 0.4 cwt. N as ammonium sulphate.
- 1946 Variety of wheat changed from Yeoman to Squareheads Master.

#### 2. The Revised Experiment, 1955-1956.

The rotation was modified by introducing beans (autumn sown when possible) instead of ryegrass ley, the present rotation being: potatoes, barley, beans, wheat.

The application of farmyard manure, straw, straw-compost and rock phosphate were discontinued. The plots originally testing dung, straw and superphosphate respectively received an annual dressing of 0.24 cwt.  $P_2O_5$  per acre applied as superphosphate, while the old compost plots received 0.12 cwt.  $P_2O_5$  annually as superphosphate. The rock phosphate plots received no phosphate. All plots had a basal dressing of 0.6 cwt.  $K_2O$  annually as muriate of potash (but see below for the beans of 1955 and the wheat of 1956)

Each plot of wheat, barley and potatoes was split for nitrogen:-

wheat and barley: none; 0.4 cwt. N per acre  
applied as sulphate of ammonia.

potatoes: 0.2; 0.6 cwt. N per acre  
applied as sulphate of ammonia.

The arrangement of the levels of nitrogen was randomised afresh each season. The beans did not receive nitrogen.

The phosphate and potash fertilisers were applied in autumn for beans and wheat, half-plots of wheat receiving a single top dressing of nitrogen in spring. All fertilisers for barley were applied to the seedbed. All fertilisers for potatoes were broadcast on the flat before planting by machine.

In 1955 the plots of beans were split into 3 for a test of potash:- none; 0.8; 1.6 cwt.  $K_2O$  per acre applied as muriate of potash. The wheat following these beans received equalising amounts of potash:-

1.6 cwt.  $K_2O$  following none; 0.8 following 0.8 and none following 1.6.

#### Subsequent cropping.

1957 After the harvest of 1956 the second scheme was terminated and the four series were each sown with 5 strips of cereals.

The cereal plots coincided with the blocks of the old rotation.

The crops were:-

Wheats: Yeoman, Squareheads Master, Cappelle; Barley: Proctor; Oats: Sun II.

Studies were made of the incidence of take-all (*Ophiobolus graminis*) and eyespot (*Cercospora herpotrichoides*) in relation to the previous cropping.

1958 In autumn 1957 the whole area was sown with winter beans.

1959 Yeoman wheat, 0.6 cwt. N as "Nitra-Shell" 20.5% N per acre. For the design of the original experiment see Rep. Rothamst. exp. Sta. for 1930, 125-126.

For summaries of the original experiment see Rep. Rothamst. exp. Sta. for 1946, 82-84, and for 1954, 153-156.

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Table 28  
FOUR-COURSE ROTATION, HOOSFIELD  
means over 21 years 1934-54.

Years after application	Farmyard manure	Straw compost	Straw	Super-phosphate	Rock phosphate	S. E.
POTATOES, tons per acre (no additional N)						
0	6.41	6.18	6.89	6.90	4.49	+0.18*
1	5.35	4.92	5.01	5.76	4.49	+0.16†
2	5.17	4.47	5.22	5.86	4.69	
3	4.79	4.51	5.10	5.74	4.54	
4	4.58	4.33	4.95	5.60	4.58	
Mean	5.26	4.88	5.43	5.97	4.56	+0.11
Response to 0.4 cwt. additional N per acre, 1942-54						
0	1.49	0.82	1.19	0.78	0.12	
1	1.82	1.47	1.59	1.00	0.81	
2	1.15	1.46	1.53	0.68	0.21	+0.28
3	1.64	0.90	1.08	0.57	0.41	
4	1.54	0.78	1.38	0.75	-0.18	
Mean	1.53	1.09	1.35	0.76	0.27	+0.12
BARLEY, grain: cwt per acre						
0	28.0	27.5	29.3	27.6	23.4	+0.41*
1	22.8	22.0	22.0	25.8	24.0	+0.48†
2	20.7	19.9	21.2	26.4	25.0	
3	19.0	19.6	20.9	26.4	24.3	
4	18.9	18.6	20.5	25.8	25.6	
Mean	21.9	21.5	22.8	26.4	24.5	+0.31
RYEGRASS, dry matter: cwt per acre, means over 18 years - 1935-40, 1942-48, 1950-54.						
0	19.2	19.5	30.9	19.5	17.6	
1	12.5	13.1	11.6	19.3	16.7	
2	11.2	10.3	12.6	18.8	17.0	
3	9.6	9.7	10.7	18.0	16.8	
4	9.6	9.8	9.6	18.0	16.6	
Mean	12.4	12.5	15.1	18.7	16.9	
WHEAT, grain: cwt per acre						
0	20.9	22.2	23.6	18.7	18.7	+0.31*
1	17.0	17.0	15.9	17.8	18.3	+0.32†
2	15.3	15.0	16.8	18.4	18.2	
3	15.1	15.2	15.7	18.1	18.3	
4	15.2	14.8	14.9	18.6	18.0	
Mean	16.7	16.8	17.4	18.3	18.3	+0.17

† S. Es. for horizontal comparisons.

\* S. Es. for vertical comparisons and interactions.

Note: All yields except those of ryegrass have been adjusted for block differences. The adjustment of the ryegrass yields is complicated, and has not been carried out; these adjustments are, however, almost certainly small, as they were in the case of the other crops, as each block has in some year carried nearly all of the treatment-phase combinations.