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

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WOBURN, STACKYARD FIELD, CONTINUOUS WHEAT AND BARLEY, 1877 ONWARDS

The experiments on wheat and barley tested the same set of manurial treatments under the same plot numbers. There were four periods: (1) 1877–1906 during which the fertiliser dressings were on much the same scale as for continuous cereals at Rothamsted; (2) 1907–26 when additional treatments were tested, most of the nitrogen dressings were halved and amounts of P and K were decreased; (3) 1927–58 when their residual effects were measured; (4) 1959–66 a more detailed study of residual effects involving direct additions of P and K on micro-plots, after the surface soils on all plots had been brought to pH6.

Commencing in 1898 certain of the plots were subdivided to test lime applications. These lime dressings are tabulated separately in Table 19.

First and Second periods, 1877-1926

Size of plot. The main plots of the original experiment were 0·25 acre.

Varieties. Many changes were made; 11 varieties of wheat and eight of barley were grown during the course of the experiment. Since 1927 the varieties have usually been Squarehead's Master wheat and Plumage Archer barley.

TABLE 18

Manures applied annually, 1877–1926

(i) *Symbols, materials and rates of application*

N1, N2: mixed ammonium salts to supply 43, 86 lb N (1877–1906) (1); sulphate of ammonia to supply 20·5, 41 lb N (1907–26)

N1*, N2*: nitrate of soda to supply 43, 86 lb N (1877–1906); 20·5, 41 lb N (1907–26)

P: 3½ cwt superphosphate (18% P_2O_5) supplying 65 lb P_2O_5 (about 30 lb P) (1877–1906); 56 lb P_2O_5 (1907–26) (2)

K: 200 lb sulphate of potash supplying 98 lb K_2O (about 80 lb K) (1877–1906); 27 lb K_2O (1907–26)

Na: 100 lb sulphate of soda supplying about 14 lb Na (3)

Mg: 100 lb sulphate of magnesia supplying about 10 lb Mg (3)

D1, D2: farmyard manure (FYM) to supply 86, 172 lb N (4)

(ii) *Treatments*

Plot (5)	
1	None
2	N1
3	N1* (6)
4	PKNaMg
5	N1PKNaMg
6	N1*PKNaMg
7	None
8	N2PKNaMg (7)
9	N2*PKNaMg (7)
10a, 10b	D1 (8)
11a, 11b	D2 (9)

Notes

(1) Equal quantities of ammonium sulphate and ammonium chloride.

(2) In the first few years, superphosphate made from 200 lb bone ash and 150 lb sulphuric acid.

(3) Not applied after 1906.

(4) Cattle were given weighed quantities of cake, roots and straw. The manure was carted, clamped under cover and applied almost immediately. The dressings were

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calculated from the known composition and weights of materials fed allowing for retention; these were usually 4–6 and 8–12 tons FYM. From 1907 the FYM was analysed and the dressing (now applied to plot 11b only) was adjusted to supply 82 lb total N. This investigation showed that before 1907 much less N had been applied than was thought at the time.

(5) Subdivisions of the plots for liming are ignored in this table. See below.

(6) From 1907 plot 3 was divided; 3a received N2* (41 lb N), 3b received N1* (20·5 lb N).

(7) 1877–82 all N in spring in two equal amounts. From 1883 N applied only in alternate years, plots being halved 8a, 8b, 9a, 9b to show direct and residual effects (PKNaMg every year). From 1907 these tests continued with 41 lb N instead of 86 lb.

(8) 10a: 1877–81, D1
1882–1906, unmanured except 1889, rape cake to supply 43 lb N
1907–26, N1*P
10b: 1877–87, D1
1888, unmanured
1889, rape cake to supply 43 lb N
1890–1906, rape cake to supply 82 lb N
1907–26, rape cake to supply 20·5 lb N

(9) 11a: 1877–81, D2
1882–1906, unmanured
1907–26, N1*K
11b: 1877–1926, D2

Liming. After 16 years of ammonium salts providing 43 lb N the barley yields on plot 2 began to decline. This plot was first limed for the crop of 1898 as was also its counterpart in wheat, which was by then also showing deterioration but to a lesser degree. Thereafter lime was applied to several of the plots in different amounts and years. The material used was high-grade burnt lime, slaked before application. The details are:

TABLE 19

Lime (CaO) cwt and years of application

	5	10	20	40
		Wheat		
2aa	1905, 1909, 1910, 1911	—	—	—
2b	—	—	—	1898
2bb	—	—	—	1898, 1905
5b	—	—	1905	—
8aa, 8bb	—	1905, 1918	—	—
		Barley		
2aa	1905, 1909, 1910, 1911	1923	—	—
2b, 5b, 8aa, 8bb	—	—	—	1898, 1912
2bb	—	—	—	1898, 1905 1912
4b	—	—	1915	—
5aa	—	—	1905, 1916	—
3aa, 3bb	—	—	—	1921

Third period, 1927-58

From 1927 to 1940 there were two cycles of two years fallow followed by five years cropping. The bare fallows were in 1927, 1928, 1934, 1935. The plots were cropped with Red Standard wheat (Million in 1929 and 1930) and Plumage Archer barley. In 1931 and 1932 the varieties Plumage and Archer were grown side by side in alternate strips on all the barley plots. The plots were unmanured except that plots 8, 9, 10a, 11a on the Barley Site received fertilisers as detailed at top of page 51.

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Plot	Super-phosphate P_2O_5 lb	Sulphate of potash K_2O lb	Sulphate of ammonia N lb	Nitrate of soda N lb
8	56	82	41	—
9	56	82	—	41
10a	56	—	—	41
11a	—	82	—	41

From 1941 to 1957 cropping was continued as before but nitrogenous fertilisers were given to all plots. In 1941 and 1942 sulphate of ammonia at 47 lb N was given as a basal dressing for both crops. In 1943 the plots, excluding 2, 5 and 8 which had received sulphate of ammonia, were divided into sets of three and dressings of 35 lb, 70 lb, 105 lb N as 'Nitro-Chalk' were applied to the plots of each set in cyclic order. The sets were:

Past treatment	Plots
No P or K	1, 3, 7
PK	4, 6, 9
Farmyard manure	11b (divided into three sections)
Various treatments	10a, 10b, 11a.

Plots 2, 5 and 8 were fallowed.

The wheat plots were fallowed in 1947, 1948, 1955, 1956, 1957; the barley plots in 1947, 1948, 1949, 1956, 1957. No crop weights were taken on either experiment in 1950. In 1952 and 1953 the barley plots were divided to compare winter and spring-sown barley. In 1958 all main plots of both experiments were divided into four sections carrying winter wheat, winter barley, spring wheat and spring barley respectively. The crops were uneven and were ploughed up in spring 1958.

TABLE 20

Continuous wheat and barley, Woburn

Plot numbers Treatment 1877–1926		1, 3, 7 No P or K	4, 6, 9 PK	10a, 10b, 11a Various	11b FYM	Mean
Wheat grain: cwt						
Means over seven years: 1944, 1945, 1949, 1951–54						
lb N 1943–54	35	8·3	9·5	8·6	11·1	9·4
	70	9·8	13·9	10·8	13·2	11·9
	105	12·1	14·5	13·3	16·3	14·1
	Mean	10·1	12·6	10·9	13·5	11·8
(1943: failed; 1946: rejected (greatest yield 6·7 cwt); 1947–48: fallow; 1950: failed; 1955: fallow)						
Barley grain: cwt						
Means over six years: 1943–46, 1952, 1953						
lb N 1943–54	35	5·6	7·2	5·8	9·0	6·9
	70	7·4	11·2	7·2	9·9	8·9
	105	8·8	10·9	6·5	11·5	9·4
	Mean	7·3	9·7	6·5	10·1	8·4

Note: No yield was recorded for plot 10a (105 lb N) in 1952. A value (10·5 cwt) was estimated and used in making the table.

(1947–49: fallow; 1950: failed; 1951: rejected—three plots not recorded (greatest yield 8·7 cwt); 1952–53: yields of spring-sown barley only; 1954: rejected—five plots not recorded; 1955: not included—lime applied.)

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Liming. In 1955 dressings of ground chalk ranging from 20 to 50 cwt, according to pH of the individual plots, were applied to both experiments in order to bring all plots to about pH 6·0.

In 1956 and again 1957 further adjustments involving dressings ranging from 7·5 to 15 cwt chalk were made to both experiments. In autumn 1963 the whole area (except for a 70-link strip on south-east of plots 4, 5, 6 crossing 11a and 11b) received ground chalk at 46 cwt to bring pH to about 7.

Fourth period, 1959-66

1959–61 All main plots divided to test Squarehead's Master wheat and Plumage Archer barley with a basal dressing of 102 lb N.

1960–62 On part of plots 7, 8, 9, 11a, 11b, on both Wheat and Barley Sites microplot experiments were made to measure residual effects of P and K against direct applications in the presence of basal N. Barley and potatoes were grown each year, sugar beet in 1961–62. The microplots were on both sites in 1960, on the Barley Site only in 1961 and the Wheat Site in 1962.

1962 Spring oats, variety Condor with a basal dressing of 56 lb N. A further small area was allocated for microplots on soil structure, occupying parts of plots 4, 5, 6, 11a and 11b of the Barley Site.

1963 Fallow except for strip of land on south-east of plot 6 of Barley Site used for an experiment on soil structure using red beet.

1964 All plots sown to spring beans except for area used for soil structure experiment.

1965 Fallow except for area used for soil structure experiment.

1966 Fallow except for area used for soil structure experiment. The measurement of the residual effects of the treatments applied to the Classical experiments has now ceased and the sites were made available for new experiments:

(i) north-west third of area for long-term phosphate experiment;

(ii) centre third available for soil structure experiments;

(iii) south-east third of area for intensive cereals experiment.

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