

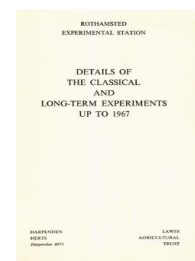
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## Details of the Classical and Long-term Experiments Up to 1967

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### Ley-arable Rotations - Rothamsted

#### Rothamsted Research

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## LEY-ARABLE ROTATION EXPERIMENT, ROTHAMSTED, HIGHFIELD AND FOSTERS FIELD, 1949 ONWARDS

This experiment was designed to study the effect of various three-year leys on the fertility of the soil as measured by a sequence of three arable test-crops. Sites in two fields were used, having soils similar in origin but contrasting in past cropping. Highfield had been under permanent grass, mainly grazed, for more than a century and plots were ploughed up as needed. Fosters had carried arable crops for many years with no long leys recently. On Highfield plots of the old turf (G) were left for comparison with the three-year leys and on both fields in the first three years other plots were sown with 'reseeded' grass (R) at the same time as the leys. Certain of the plots of 'reseeded' grass were ploughed later for test-cropping.

Yields of all crops have been recorded throughout, the yields of grass under grazing being estimated from samples. Changes in the amounts of organic matter and of available P and K in the soils have been assessed periodically.

The main comparisons have been between four rotations, each of six years' duration. The 'arable with hay' rotation has always included a one-year ley cut for hay. The other three have had three-year leys of different species and different management, followed by three arable crops; the latter also occurred in the 'arable with hay' rotation and are referred to as test-crops.

Plots of these four rotations together with 'reseeded' grass and (Highfield only) 'permanent' grass were laid down in randomised blocks of five or six plots each. On each field there were 12 blocks, two in each phase of the six-year cycle. The whole experiment was started in the three seasons 1949, 1950 and 1951; blocks due to start treatment cropping in 1952, 1953 and 1954 started three years earlier with 'dummy' test-crops.

	Highfield						Fosters					
Phase	A	B	C	D	E	F	A	B	C	D	E	F
1947		Old grass (G)						Ley (second year)				
1948		Old grass (G)						Barley				
1949	W	Tr1	G	G	G	G	W	Tr1	B	B	B	B
1950	P	Tr2	W	Tr1	G	G	P	Tr2	W	Tr1	B	B
1951	B	Tr3	P	Tr2	W	Tr1	B	Tr3	P	Tr2	W	Tr1

G = old grass.

Tr1, 2, 3 = treatment crops, first, second, third years.

W = wheat, P = potatoes, B = barley.

Each plot was 0.088 acre.

During the course of the experiment many changes have been introduced; these are given in detail below. Because of the presence of all phases of the rotation some changes (e.g. in seeds mixtures for three-year leys) took effect over several years.

The history of the experiment can nevertheless be divided roughly into three periods. The management of grass and leys is given in a separate section (see page 86).

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### First period, 1949–54

The rotations compared were:

	Year	Rotation and symbol			
		Lucerne Lu	Grazed ley L	Cut grass Cg	Arable with hay A
Treatment crops	1	Lucerne	Grazed ley	Cut grass	One-year hay
Treatment crops	2	Lucerne	Grazed ley	Cut grass	Potatoes
Treatment crops	3	Lucerne	Grazed ley	Cut grass	Barley
Test crops	4	Wheat	Wheat	Wheat	Wheat
Test crops	5	Potatoes	Potatoes	Potatoes	Potatoes
Test crops	6	Barley	Barley	Barley	Barley*

\* Undersown.

During the first period each plot received 2.4 cwt  $P_2O_5$  and 2.4 cwt  $K_2O$  in the six-year cycle, though the rates of application in any one year were not the same on all rotations (see Table 37).

All treatment crops (except lucerne which received no nitrogen) were grown yearly at low nitrogen level (N1) and at high nitrogen level (N2) and the subsequent test-crops were similarly treated. These treatments were factorial on quarter plots (N1 v. N2 on treatment crops)  $\times$  (N1 v. N2 on test-crops), all dressings being cumulative (see Table 36).

Farmyard manure at 12 tons per acre was tested on all potato crops, the test-crop on all four rotations and the treatment crop of the arable rotation. The residual effect of FYM appears in the following cereal crops and leys, so the quarter plots gave the following arrangement:

Rotation	Applied to treatment crops	Applied to test crops	Replication on each field in each phase
Lucerne	Nil	$\times$ (N1 v. N2)(0 v. FYM)	2
Ley, cut grass	(N1 v. N2)	$\times$ (N1 v. N2)(0 v. FYM)	1
Arable	(N1 v. N2)(0 v. FYM)	$\times$ (N1 v. N2)(0 v. FYM)	$\frac{1}{2}$

### Second period, 1955–60

Spring oats were introduced instead of barley as the third treatment crop of the 'arable with hay' rotation in order to lessen the risk of infection of the wheat with eyespot (*Cercospora herpotrichoides*) or take-all (*Ophiobolus graminis*).

The most important change made at the beginning of the second period arose out of an examination of potash withdrawals in the various treatment crops. Soil and plant analysis had shown that very different amounts of K were being removed from the soil by the various grass crops. Plots growing hay, cut grass and lucerne lost much more K than the grazed plots. This difference was believed to be big enough to affect the yields of the test-crops. In 1955–59 in order to correct these deficiencies dressings of fertiliser K were applied before the first treatment crops were sown (and in 1955 in one phase to second treatment crops) and to the R and G plots

## ROTHAMSTED LEY-ARABLE

in the same blocks. On these plots the basal dressings in later years were supplemented by fertiliser K at rates chosen to make good the removal anticipated in the subsequent year's crop. The amounts actually given year by year are shown in Table 38 below.

At the same time a scheme was adopted to measure differential potash (and phosphate) responses in test-crop potatoes following the different leys. The original quarter plots were split to test an extra 0.9 cwt  $K_2O$ , and also an extra 0.9 cwt  $P_2O_5$  in addition to the basal dressing, i.e. (0.9 v. 1.8 cwt  $K_2O$ )  $\times$  (0.9 v. 1.8 cwt  $P_2O_5$ ). From 1955 to 1957 these tests were made on plots that had not yet received supplementary K to the previous grass crop; from 1958 to 1964 they were made on plots that had received three or more supplementary dressings. Eighth-plots that received the lesser amount of P for potatoes received an equalising dressing of 0.9 cwt  $P_2O_5$  for the following barley crop, and similarly for K.

From 1958 the standard applications of P and K were revised; each six-year rotation received more P and K than in the first period and the totals for the four rotations were different. Details appear in Table 37 below. Some of the corrective dressings of K applied in 1958 and 1959 were based on the results of later soil analysis. Similarly the arable rotation (all phases) received corrective K in 1961.

### Third period, 1961–67

Sugar beet was put in place of potatoes as the second treatment-crop of the 'arable with hay' rotation, and the test of FYM to second treatment-crop was omitted from 1961. Although sampling showed no appreciable number of cyst-nematodes (*Heterodera rostochiensis*) the principle was accepted that the treatment-crops should be chosen to minimise any soil-borne pathogen likely to damage other crops in the experiment, especially the test-crops.

From 1961 all sub-plot tests of manures to treatment-crops were discontinued and this allowed more elaborate tests on the test-crops. In particular, wheat and barley both received N at four rates (the two tests being factorial) and response curves were studied in some detail.

From 1962 no more plots were sown to 'grazed-ley' or 'cut grass'. Instead two new types of three-year ley were introduced:

- (i) All-grass (symbol 'Ln') receiving much fertiliser N; on former 'Cg' plots.
- (ii) Clover-grass (symbol 'Lc') receiving no fertiliser N; on former 'L' plots.

From 1962 FYM for potatoes was applied in autumn and ploughed in (until 1961 it was applied in furrows before planting). From 1962 potatoes were planted by machine.

From 1963 certain plots of 'reseeded' grass were ploughed up; some had been down for 12 years, others for 15. These plots went into the test-crop sequence and then into the 'arable with hay' treatment-crops.

Details of N tests and standard applications of P and K in this period are shown in Tables 36 and 37.

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**TABLE 36**

*Ley-arable rotation experiment, Rothamsted*

Standard and test N (cwt N)

*First and second periods 1949-60*

Year	Lu	L	Cg	A	R and G
First treatment	0	0.075 v. 0.15*	0.15 v. 0.3†	0.3 v. 0.6	0.075 v. 0.15*
Second treatment	0	0.075 v. 0.15*	0.15 v. 0.3†	0.5 v. 1.0	0.075 v. 0.15*
Third treatment	0	0.075 v. 0.15*	0.15 v. 0.3†	0.2 v. 0.4	0.15 v. 0.3*
First test	Lu, L, Cg, A: 0.3 v. 0.6				0.075 v. 0.15*
Second test	Lu, L, Cg, A: 0.5 v. 1.0				0.075 v. 0.15*
Third test	Lu, L, Cg, A: 0.2 v. 0.4**				0.15 v. 0.3*

\* In spring and again in summer; in year of sowing the spring dressing was to seedbed; for R and G in hay years the summer application was after the hay cut for aftermath grazing.

† In spring (seedbed in year of sowing) and again after each cut except the last.

\*\* From 1955: 0 v. 0.2 (Highfield), 0.2 v. 0.4 (Fosters).

*Third period 1961-67*

Year	Lu	L	Lc	Cg	Ln	A
First treatment	0	0.11*	0	0.22†	0.6†	0.6*
Second treatment	0	0.11*	0	0.22†	0.6†	1.0**
Third treatment	0	0.11*	0	0.22†	0.6†	0.2 (Highfield) 0.4 (Fosters)

First test§ (Highfield) All rotations: 0 v. 0.3 v. 0.6 v. 0.9  
(Fosters) All rotations: 0 v. 0.4 v. 0.8 v. 1.2

Second test‡ (Highfield) All rotations: 0.75 v. 1.25  
(Fosters) All rotations: 1.0 v. 1.5

Third test§§ (Highfield) All rotations: 0 v. 0.1 v. 0.2 v. 0.3  
(Fosters) Lu, L, Cg: 0 v. 0.2 v. 0.4 v. 0.6  
A: 0 v. 0.4 v. 0.6 v. 0.8

R and G: 'Silage' years 0.3\*

'Grazing' years 0.11\*

From 1962 R, and from 1963 G plots, were split (at right angles to the earlier split) for fertiliser and management corresponding to Lc and Ln; N (cumulative) at none (Rc, Gc) and 0.6 (Rn, Gn) per cut.

\* In spring (in seedbed for first-year grazed ley) and again in summer (after first cut on one-year hay and 'silage' plots).

† In spring (seedbed in year of sowing) and again after each cut except the last.

\*\* Test of 1.0 v. 1.5 in 1964. From 1965 1.5 standard.

§ From 1964 rates for the 'arable' rotation were 0 v. 0.4 v. 0.8 v. 1.2 on Highfield; 0 v. 0.53 v. 1.07 v. 1.6 on Fosters. Also from 1965 a test was made on all rotations of 0 v. 0.6 applied in autumn/winter.

‡ 1965: 1.2 standard (no test). 1966 and 1967: standard 1.2 plus 0.3 additional to sub-plots without FYM.

§§ In 1961 tests were 0 v. 0.2 on Highfield; Fosters, Lu, L, Cg, 0.2 v. 0.4, A 0.3 v. 0.6.

*Materials.* All N applied as 'Nitro-Chalk' except that:

- (a) potatoes received sulphate of ammonia;
- (b) standard N in a few cases was applied as NPK compound;
- (c) where appropriate NK compound (16:0:16) was applied to grasses during the growing season.

*Time of application.* Except as indicated, all N was applied in spring, in seedbed for spring-sown crops, top-dressed for others.

## ROTHAMSTED LEY-ARABLE

TABLE 37

### Ley-arable rotation experiment, Rothamsted

Standard applications of P and K (cwt) omitting supplementary K (see Table 38 below) and test P and K to potatoes, and 'balancing' P and K to barley (see text, p. 80). (The figures in this table are the rates applied in the years indicated; because of phasing the totals given do not necessarily correspond with the totals applied to any given plot.)

#### First and part of second period 1949-57

Year	Lu		L		Cg		A	
	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
First treatment	0.6	0.6	0.6	0.6	0.6	0.6	0.15*	0.15*
Second treatment	0.3	0.3	0.3	0.3	0.3	0.3	0.9	0.9
Third treatment	0.3	0.3	0.3	0.3	0.3	0.3	0.15	0.15
First test	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Second test	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Third test	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Total	2.4	2.4	2.4	2.4	2.4	2.4	2.4**	2.4**

R and G: 0.3 P<sub>2</sub>O<sub>5</sub>, 0.3 K<sub>2</sub>O in 'grazing' years  
 0.6 P<sub>2</sub>O<sub>5</sub>, 0.6 K<sub>2</sub>O in 'hay' years.  
 (Totals over six years 2.4 P<sub>2</sub>O<sub>5</sub>, 2.4 K<sub>2</sub>O till 1954, then 2.1 P<sub>2</sub>O<sub>5</sub>, 2.1 K<sub>2</sub>O)

\* 0.6 P<sub>2</sub>O<sub>5</sub>, 0.6 K<sub>2</sub>O from 1958.  
 \*\* 2.85 P<sub>2</sub>O<sub>5</sub>, 2.85 K<sub>2</sub>O from 1958.

#### Remainder of second period 1958-60

Year	Lu		L		Cg		A	
	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
First treatment	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Second treatment	0.9	1.8	0.3	0.6	1.2	1.2	0.9	1.8
Third treatment	0.9	1.8	0.3	0.6	1.2	1.2	0.15	0.3
First test	0.15	0.3*	0.15	0.3*	0.15	0.3*	0.15	0.3*
Second test	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Third test	0.15	0.3	0.15	0.3	0.15	0.3	0.15	0.3
Total	3.6	5.7**	2.4	3.3**	4.2	4.5**	2.85	4.2**

R and G: 0.3 P<sub>2</sub>O<sub>5</sub>, 0.6 K<sub>2</sub>O in 'grazing' years  
 0.6 P<sub>2</sub>O<sub>5</sub>, 1.2 K<sub>2</sub>O in 'silage' years  
 (Totals over six years, 2.7 P<sub>2</sub>O<sub>5</sub>, 5.4 K<sub>2</sub>O)

\* 0.15 K<sub>2</sub>O in 1958.  
 \*\* 1958: (Lu) 5.55, (L) 3.15, (Cg) 4.35, (A) 4.05.

#### Third period 1961-67

1961	Lu		L†		Cg†		A	
1962-67	Lu		Lc		Ln		A	
Year	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
First treatment	0.6	0.6	0.6	1.2*	0.6†	1.2*	0.6	1.2§
Second treatment	0.9	1.8	0.6	1.2*	0.6	1.2*	1.0	2.4
Third treatment	0.9	1.8	0.6	1.2*	0.6	1.2*	0.3	0.6
First test**	0.3	0.6	0.3	0.6	0.3	0.6	0.3	0.6
Second test††	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Third test	0.3	0.6	0.3	0.6	0.3	0.6	0.3	0.6
Total	3.9	6.3	3.3	5.7*	3.3	5.7*	3.4	6.3

R: manuring as second period until 1962. Plots in blocks coming into first test-crop (wheat) were ploughed up in autumn 1962, 1963 and 1964 and cropped with test crops then as rotation 'A'. Remaining plots received 0.6 P<sub>2</sub>O<sub>5</sub>, 1.2 K<sub>2</sub>O plus 0.6 K<sub>2</sub>O for each cut.

G: as second period until 1961, then 0.6 P<sub>2</sub>O<sub>5</sub>, 1.2 K<sub>2</sub>O plus 0.6 K<sub>2</sub>O for each cut.

(For notes see next page)

## ROTHAMSTED LEY-ARABLE

\* The new leys Ln and Lc introduced from 1962 onwards received standard 0.6 P<sub>2</sub>O<sub>5</sub>, 1.2 K<sub>2</sub>O in seedbed for first year and in winter for second and third years. In addition they received 0.6 K<sub>2</sub>O for each cut except the first—total amount per annum depending on numbers of cuts (two to three cuts in first year, four to five cuts in second and third years).

† The old leys L and Cg, present until autumn 1963, were manured as follows:

	L		Cg	
	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
First year	0.6	0.6	0.56	0.56
Second and third years	0.6	1.2	1.2	1.2

In addition Cg plots in the second and third years received 0.22 K<sub>2</sub>O for each cut.

§ 0.6 K<sub>2</sub>O (with P<sub>2</sub>O<sub>5</sub>) in winter (seedbed from 1966) and 0.6 K<sub>2</sub>O after first cut.

\*\* In 1965 wheat received an additional 0.6 K<sub>2</sub>O applied to the plough furrow. In 1966 and 1967 wheat received 0.45 P<sub>2</sub>O<sub>5</sub>, 0.9 K<sub>2</sub>O ploughed in plus 0.45 P<sub>2</sub>O<sub>5</sub>, 0.9 K<sub>2</sub>O broadcast before sowing.

†† Sub-plots without FYM received in addition 0.6 P<sub>2</sub>O<sub>5</sub>, 0.9 K<sub>2</sub>O (1961–64).  
Manuring 1965–67:

	1965		1966–67	
	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
Standard	1.2	1.2	1.8	1.8
Additional to no-FYM sub-plots	0.5	1.0	0.7	0.7

All as superphosphate and muriate of potash.

*Methods of application.* Except where otherwise stated in the table P and K were applied as follows:

Wheat, barley, oats: combine drilled.

First-year leys (all types, but excluding one-year hay when undersown in barley): broadcast on seedbed.

Established leys, permanent and reseeded grass, one-year hay (undersown): broadcast in winter.

Potatoes: in furrows until 1960; in 1961 test N (0 v. 0.5 N) was broadcast before ridging, as were the 0.6 P<sub>2</sub>O<sub>5</sub>, 0.9 K<sub>2</sub>O to sub-plots without FYM (remaining fertilisers in furrows); from 1962 broadcast on flat before planting.

Sugar beet: broadcast in seedbed.

*Materials.* Except where otherwise stated P and K were applied as PK compound fertilisers of ratio (0:1:1) or (0:1:2). In a few cases an NPK compound was used. K applied to grasses during the growing season was as compound (16:0:16) where applied with N, otherwise as muriate of potash. Test P and K to potatoes (and balancing dressings to barley) were as superphosphate and muriate of potash, the test dressings were applied in furrows till 1961, on flat from 1962, the balancing dressings in winter after ploughing.

Table 38 is on page 84.

## ROTHAMSTED LEY-ARABLE

**TABLE 38**

*Ley-arable rotation experiment, Rothamsted*

Supplementary potash dressings applied 1955–61 only  
(cwt K<sub>2</sub>O, as muriate except 1961)

Rates applied in Highfield (H) and Fosters (F) were equal except as indicated.

Year	Phase	Lu	Cg	R	G	
1955	First treatment	2.4	2.4	2.4	2.4	
	Second treatment	0.6	1.2	1.2	1.2	
1956	First treatment	3.0	3.0	1.2	1.2	
	Second treatment	1.0	1.5	—	—	
	Third treatment	1.0	1.5	—	—	
1957	First treatment	3.0	3.0	1.0	1.0	
	Second treatment	1.0	1.5	1.0	1.0	
	Third treatment	1.0	1.5	—	—	
	First test	1.0	1.5	—	—	
1958	First treatment	3.0	3.0	2.4	2.4	
	Second treatment	1.2	2.4	1.2	1.2	
	Third treatment	(H)	1.2	3.6	—	—
		(F)	1.2	3.0	—	—
	First test	1.2	1.2	—	—	
	Second test	(H)	2.7	2.7	—	—
(F)		3.0	2.7	—	—	
1959	First treatment	(H)	3.0	3.5	3.0	2.5
		(F)	4.0	4.0	3.0	—
	Second test	(H)	0.6	2.4	—	—
		(F)	1.2	1.8	—	—
1960	None					
1961	All phases, 'A' only, 3.0 as sulphate of potash					

All were applied in winter or early spring, except that the heavier dressings to grasses were sometimes divided, some in winter, some after first cut.

**TABLE 39 (continued)**

*Ley-arable rotation experiment, Rothamsted*

Seeds, mixtures and varieties

2. *Arable crops*

- (a) Wheat\* 1949–58 Yeoman  
1959–67 Cappelle
- (b) Potatoes: 1950–67 Majestic (chitted seed from 1963)
- (c) Barley\* 1951–53 Plumage Archer  
1954–63 Proctor  
1964–67 Maris Badger
- (d) Sugar beet: 1961–67 Klein E
- (e) Oats\* 1955–62 Sun II  
1963–66 Condor  
1967 Manod

\* 16 rows per half plot until 1966, then 15 rows.



## ROTHAMSTED LEY-ARABLE

TABLE 39

### *Ley-arable rotation experiment, Rothamsted*

Seeds mixtures and varieties

1. *Seeds mixtures of leys*

- (a) *One-year hay*: 18 lb Perennial Ryegrass (S.24)  
                           8 lb Late-Flowering Red Clover  
                           2 lb Alsike Clover  


---

                           28 lb

Sown at 28 lb (40 lb until 1954).

The seeds undersown in the barley of 1964 failed and were replaced by S.22 Italian ryegrass sown in spring at 38.5 lb. This strain has been used since then, at the same rate, not undersown but sown in autumn or spring according to conditions.

- (b) *Lucerne*: Du Puits (Provence in 1949) at 20 lb in 18-in. rows (12 in. until 1954) (34 lb until 1952, 28 lb 1953–60). From 1964 paraquat used to control grass weeds on second- and third-year crops. Sown in the open.

- (c) *Grazed ley and 'reseeded' grass*:

- 5 lb Italian Ryegrass  
 8 lb Perennial Ryegrass (S.23)  
 8 lb Perennial Ryegrass Kent Indigenous  
 4 lb Cocksfoot (S.26)  
 4 lb Cocksfoot (S.143)  
 2 lb Timothy (S.48)  
 2 lb Timothy (S.50)  
 6 lb Late Flowering Red Clover  
 ½ lb New Zealand White Clover  
 ½ lb Kent Indigenous White Clover
- 
- 40 lb

Sown at 44 lb (56 lb until 1954). Sown in the open.

- (d) *Cut grass ley*:

- 6 lb Italian Ryegrass  
 16 lb Cocksfoot (S.26)  
 4 lb White Clover (S.100)  
 2 lb Alsike Clover
- 
- 28 lb

Sown at 33 lb (40 lb until 1954). Sown in the open.

- (e) *Clover-grass ley*:

- 5 lb Timothy (S.51)  
 6 lb Meadow Fescue (S.215)  
 1 lb White Clover (S.100)
- 
- 12 lb

Sown at 33 lb in the open.

- (f) *All-grass ley*:

- 5 lb Timothy (S.51)  
 6 lb Meadow Fescue (S.215)
- 
- 11 lb

Sown at 30 lb in the open. Sowings in 1962 and 1963 were of Cocksfoot (S.37) at 30 lb: the second year failed on Highfield in 1963 and was resown to Cocksfoot; the third year failed on Fosters in 1964 and was resown to ryegrass (Italian at 40 lb).

(Continued opposite)

## ROTHAMSTED LEY-ARABLE

### Management of grass and leys

NPK manuring is shown in Tables 36, 37 and 38.

#### First period, 1949–54

**Grazed ley, permanent and ‘reseeded’ grass.** The permanent and ‘reseeded’ grass were managed in a three-year cycle, two years sheep grazing and one-year hay with aftermath grazing. The three-year ley was grazed by sheep and never cut.

The following six grass treatments each had its own team of grazing sheep which moved round the replicates for as many cycles as the season would permit. The number of grazing days and the live weight gains were recorded:

- (1) Three-year ley, all ages, low N level, six plots per field.
- (2) Three-year ley, all ages, high N level, six plots per field.
- (3) ‘Reseeded’ grass, low N level, eight plots per field (12 after hay cutting).
- (4) ‘Reseeded’ grass, high N level, eight plots per field (12 after hay cutting).
- (5) Old permanent grass, low N level (Highfield only), eight plots (12 after hay cutting).
- (6) Old permanent grass, high N level (Highfield only), eight plots (12 after hay cutting).

Grazing was by quarter plots of 0.022 acre which gave food for one day only. When a fold was ready for grazing a single transverse cut located at random was made with a ‘Roto-scythe’ to give an estimate of yield and provide material for analysis. The aim was to graze down to the level of the sample cut in one day. The stocking varied between four and seven sheep per fold. No leaving cut was made. Sheep were weighed at the beginning of a grazing cycle but were not weighed again till there was no more keep for them on any of the replicates of their appropriate treatment.

**Cut grass ley.** Cut repeatedly for all three years at the late silage stage, with sample yield cuts.

**Lucerne.** Cut repeatedly for all three years at the silage stage. Yields from quarter plots.

**One-year hay.** Cut once, with sample yield cuts.

## ROTHAMSTED LEY-ARABLE

### Second period, 1955–60

As first period except:

- 1955 Hay from permanent and 'reseeded' grass taken once in six years instead of once in three. From 1956 the first year blocks were chosen for the hay crops.
- 1958 Grazing days only recorded on all grazed plots; no further sheep weights were taken. Cutting hay from the old and 'reseeded' grass plots was discontinued. Of the two plots of each type of grass in each phase, one was grazed as soon as it was fit, the other was shut up for an early silage crop. These treatments were applied in alternate years.
- 1960 Yields of arable hay, cut grass and silage were estimated from two cuts 40 inches wide taken through each sub-plot with a flail-type forage harvester.

### Third period, 1961–67

As second period except:

**Permanent and 'reseeded' grass.** From 1962 (permanent grass) and 1963 ('reseeded' grass) grazing was discontinued. Cut repeatedly at early silage stage with sample yield cuts.

**Clover-grass and all-grass ley.** From 1962, cut at early silage stage with sample yield cuts.

**One-year hay.** Cut twice, late spring and summer.

### Liming

On Highfield in 1949–51 each set of four blocks received a corrective chalking in autumn as they came into experiment. In autumn 1952 a scheme of maintenance dressings was started, ground chalk being applied at the rate of 20 cwt CaO once every six years before barley. Commencing in 1958 the dressing was increased to 46 cwt of ground chalk.

On Fosters only, blocks 10, 11 and 12 needed a corrective dressing. This was applied at the rate of 2 tons ground chalk in spring, 1951.

### References

- For a summary of the results to 1960, see *Rep. Rothamsted exp. Stn for 1961*, 173–180.  
For a summary of the results to 1964, see *Rep. Rothamsted exp. Stn for 1965*, 216–221.  
For a summary of the results to 1967 (together with those of the Woburn Ley-Arable Experiment), see *Rep. Rothamsted exp. Stn for 1967*, 316–331.  
For yields of leys and permanent and reseeded grass to 1960, see Dyke, G. V. (1964) *Why leys? Expl Husb.* **10**, 101–111.