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Details of the Classical and Long-term Experiments 1968-73



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R/RN/1 and R/RN/2 Ley/ARABLE - Old, Grass, Leys, Wheat, Barley, Oats, Potatoes, Sugar Beet

Rothamsted Research

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LEY-ARABLE ROTATION ROTHAMSTED, HIGHFIELD AND FOSTERS FIELD (R/RN/1 & R/RN/2)

Full details of this experiment from its initiation in 1949 are set out in *Details 1967*, pp 78-87 but certain alterations and amplifications should be noted:

- (a) Table 36. First and second periods 1949-60; R and G plots. The entry '0.15 v. 0.3⁺' applies to all hay years. These were:

1951-54	Blocks in 3rd treatment and 3rd test.
1955	Blocks in 3rd treatment only.
1956-57	Blocks in 1st treatment only.

From 1958 hay cutting of 'R' and 'G' 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 grazed after an early silage cut. All these plots received N at 0.075 v. 0.15 cwt in spring and again in summer (after cutting on silage plots).

- (b) The dates of ploughing certain reseeded 'R', and permanent, 'G' grass (*Details 1967*, p.80) and their subsequent cropping from 1963 are shown in Table 1. The statement that 'R' and 'G' plots were split for fertiliser treatment in 1962 and 1963 respectively should have the years reversed (p 81). The 'R' plots which were not split continued under the earlier management until they were ploughed.
- (c) Table 37. Although covered by the footnote on p 83 it should be noted that the amounts of potash shown as applied in the treatment years to the Cg plots from 1958 do not include the 0.22 cwt K₂O per cut applied as a NK (16-0-16) dressing.

- (d) Replace the first paragraph on p 83 with the following:

The new leys Ln and Lc introduced from 1962 onwards received standard 0.6 cwt P₂O₅ and 1.2 cwt K₂O in the seedbed for the first year and as a top dressing in winter for the second and third years. In addition they received 0.6 cwt K₂O for each cut except:
the first cut of 1Lc, 1Ln in 1962-67
the first cut of 2Lc and 3Lc in 1962-65
the first cut of 2Ln and 3Ln in 1962-64

- (e) The footnote⁺⁺ to table 37 on page 83 is more clearly stated:

Standard manuring to potatoes as second test crop was increased for the years 1965-67. Sub-plots without FYM received additional P and K 1961-67.

	1961-64		1965		1966-67	
	P ₂ O ₅	K ₂ O	P ₂ O ₅	K ₂ O	P ₂ O ₅	K ₂ O
Standard	0.9	0.9	1.2	1.2	1.8	1.8 (cwt)
Additional to no FYM plots	0.6	0.9	0.5	1.0	0.7	0.7(cwt)

- (f) The yields of herbage crops other than lucerne were estimated from a single central cut of a forage harvester from 1961 instead of two (*Results*

1967, p.87). The samples of lucerne have been cut by mower throughout but the discards have been cut by forage harvester from 1969.

Fourth period 1968-

In 1968 the fourth period of this experiment started and the cropping sequences are set out in table 1. Two phases (A and B) in each field are being maintained to study the effects of treatments on changes in soil organic matter. In one of these, Phase B, the 'reseeded' plots ploughed up in 1964 were sown down again in 1973 in order to restore the original pattern.

In the remaining four phases (C-F) the normal test crop sequence is being followed by continuous wheat cropping to study soil-borne cereal diseases.

Notes and Symbols

<i>Symbols:</i>	Lu	Lucerne
	Lc	Grass/clover ley receiving no N
	Ln	All grass ley receiving fertiliser N
	G	Old grass (Highfield only) (Gn receives N; Gc receives no N)
	R	Reseeded grass sown 1949, 1950, 1951 except Phase B resown in 1973 also (Rn receives N; Rc receives no N)
	W	Wheat
	P	Potatoes
	B	Barley
	H	1-year hay
	SB	Sugar beet
	O	Oats

Treatment crop sequences:

Lu	Lu	Lc	Ln	A
(Tr1) First year	Lucerne	Clover-grass	All grass	Hay
(Tr2) Second year	Lucerne	Clover-grass	All grass	Sugar beet
(Tr3) Third year	Lucerne	Clover-grass	All grass	Oats

Test crop sequences:

	To 1968	1968 -
First year	W	P
Second year	P	W
Third year	B	B

The original sequence, if started before 1968, was completed. At the same time varieties of crops were changed to King Edward, Joss Cambier and Julia respectively (see below).

- NOTES.** 1. In 1970-72 in Phase A the normal arable treatment sequence of crops was replaced by barley, hay, sugar beet, as a four-year sequence was planned in order to provide a comparison with Saxmundham in 1974 but this was abandoned and the test crop sequence was started normally in 1973.
2. The permanent grass in one whole plot of Phase B was ploughed by mistake in 1963 and was reseeded under wheat in 1964 but the results have been excluded subsequently.

Manuring

(1) Treatment crops

	Standard N dressings (kg N)			
	Lu	Lc,Rc,Gc	Ln,Rn,Gn	A
First	0	0	75 for each cut	75 for each cut (hay)
Second	0	0	75 for each cut	188 (sugar beet)
Third	0	0	75 for each cut	25 (oats)

	Standard P and K dressings (kg P ₂ O ₅ and K ₂ O)					
	Lu		L,R,G		A	
	P ₂ O ₅	K ₂ O	P ₂ O ₅	K ₂ O	P ₂ O ₅	K ₂ O
First	75	75	75	150	75	75 + 75 after each cut except the last. (Note 2).
Second	115	230	75	150	125	300
Third	115	230	75	150	38	75

(see Note 1)

(see Note 1)

Note 1: The supplementary potash dressings (in addition to the PK one given in autumn or in the seedbed in the case of L1) for the leys and grass were altered during the period:—

1968-69	R,G,L	75 kg K ₂ O	for each cut
1970-	R,G,2L,3L	48 kg K ₂ O	for each cut
1970 & 1973	1L	48 kg K ₂ O	after each cut except the last and resown in 1973.

Note 2: Applied as (15-15-15). When this fertiliser was discontinued, (25-0-16) was substituted in 1971 keeping N rate unchanged so K₂O became 48.

Note 3: Because of the change in the treatment crops in phase A the manuring in the arable sequence was according to the crop grown in the following years:

1970	— Barley (first treatment)	50 kg N, 38 kg P ₂ O ₅ , 75 kg K ₂ O
1971	— Seeds hay (second treatment)	as for first normal treatment
1972	— Sugar beet (third treatment)	as for second normal treatment

(2) Test crops

- (i) *Potatoes as first crop:*
(for manuring of potatoes as second test crop see *Details 1967*, pp 81-83).

Table 1 Ley-Arable Experiment Rothamsted Cropping, 1962-73

PHASE	A	B	C	D	E	F
Rotation	Lu, Lc Ln, A	Lu, Lc Ln, A	Lu, Lc Ln, A	Lu, Lc Ln, A	Lu, Lc Ln, A	Lu, Lc Ln, A
1962	P R G	Tr2 R G	W R G	Tr1 R G	Tr3 R G	B R G
1963	B R G	Tr3 R *G	P R G	Tr2 R G	W R G	Tr1 R G
1964	Tr1 R G	W R *G	B R G	Tr3 R G	P R G	Tr2 R G
1965	Tr2 R G	P R G	Tr1 R G	W R G	B R G	Tr3 R G
1966	Tr3 R G	B R G	Tr2 R G	P R G	H R G	W R G
1967	W R G	Tr1 R G	Tr3 R G	B R G	S R G	P R G
1968	P R G	Tr2 R G	P R G	WHEAT	Tr3 O G	B R G
1969	B R G	Tr3 R G	W R G	WHEAT	P	WHEAT
1970	Tr1+B† R G	P R G	B R G	WHEAT	W	WHEAT
1971	Tr2+H R G	W R G	WHEAT	WHEAT	B	WHEAT
1972	Tr3+SB R G	B R G	WHEAT	WHEAT	WHEAT	WHEAT
1973	P R G	Tr1 R G	WHEAT	WHEAT	WHEAT	WHEAT

† See Note 1. * See Note 2.

- (a) Supplementary K dressings (kg K₂O) calculated to bring the K levels on both fields up to that of the Fosters Lc plots were ploughed in during the autumn for the 1968-70 crops. These supplementary K dressings were only given for the first test crop potatoes in these years and have not been applied subsequently.

Rotation	Fosters			Highfield		
	1968	1969	1970	1968	1969	1970
A	690	590	550	840	930	670
Lu	480	580	360	600	540	460
Lc	0	0	0	75	25	25
Ln	365	615	188	550	680	450
Rc	0	—	—	0	—	—
Rn	440	—	—	440	—	—
R+	—	770	490	—	880	550
Gc	—	—	—	—	not	—
Gn	—	—	—	440	corrected 430	—

+ These had carried the 'arable' rotation for 6 years after ploughing up.

- (b) Standard and test dressings (kg)
1968-70

FYM. Tested at 0 v. 30 t on ¼ plots cumulatively with applications to previous test crop potatoes. In 1968 and 1969 no FYM was applied to the R and G plots (phases C and E) coming with potatoes and these plots were treated as F plots.

Nutrient	Test	Standard	FYM Equiv. (to plots without FYM)	Total
N (1/8 plots)	0 v. 75 v. 150 v. 225	—	—	0 v. 75 v.150 v. 225
P ₂ O ₅ (1/16 plots)	0.v. 115	190+	55	No FYM 245 v. 360
K ₂ O (1/16 plots)	0 v. 115	115	115	No FYM 230 v. 345 FYM 115 v. 230

+In 1968 300 on both fields: because of an excess application to Fosters Field the dressing on Highfield was equalised. Applications were:

300	55	No FYM 355 v. 470
		FYM 300 v. 415

1971 and 1972 no potatoes
1973 Test N 0 v. 80 v. 160 v. 240 kg N

No P and K test, standard only at 300 kg P₂O₅ and 300 kg K₂O
No fresh FYM test

- (ii) *Wheat as second test crop* (only present in 1969, 1970 and 1971):
N test on 1/8 plots 0 v. 50 v. 100 v. 150 kg N
Standard dressings 50 kg P₂O₅ plus 50 kg K₂O ploughed down
63 kg P₂O₅ plus 63 kg K₂O combine drilled
- (iii) *Wheat as fourth and subsequent test crop:*
- | | | |
|---------|--|--|
| 1968 | N test (Highfield)
on ¼ plots (Fosters) | 38 v. 75 v. 115 v. 150 kg N
50 v. 100 v. 150 v. 200 kg N |
| | Standard dressings | 115 kg P ₂ O ₅ and 115 K ₂ O half
combine drilled and half after
drilling |
| 1969-70 | N test (both fields)
on ¼ plots | 75 v. 125 v. 175 v. 225 kg N |
| | Standard dressings | 50 kg P ₂ O ₅ , 50 kg K ₂ O ploughed
down
63 kg P ₂ O ₅ , 63 kg K ₂ O combine
drilled |
| 1971-73 | N as 1969-70 | |
| | Standard dressings | 75 kg P ₂ O ₅ , 75 kg K ₂ O combine
drilled |
- (iv) *Barley as third test crop*
N test on 1/8 plots
- | | | |
|---------|------------------------------|------------------------------|
| 1968-69 | Highfield - all rotations | 0 v. 12.5 v. 25 v. 37.5 kg N |
| | Fosters Lu, Lc, Ln rotations | 0 v. 25 v. 50 v. 75 kg N |
| | Fosters A rotation | 0 v. 50 v. 75 v. 100 kg N |
| 1970-72 | Both fields all rotations | 0 v. 50 v. 90 v. 125 kg N |
- Standard P and K
1968-72 38 kg P₂O₅ and 75 K₂O
There was no test barley in 1973

Liming

Highfield only. 5.8 t of ground chalk were applied to the two blocks for the third test crop barley (and grass where present in the same blocks) 1968-72. None since.

Materials

Compound fertilisers were used wherever practicable; they included (0-14-28); (0-20-20); (25-0-16); (16-0-16 up to 1968). 'Nitro-Chalk', superphosphate or muriate of potash were used where a single nutrient was required or no suitable compound was available or in a small number of cases to supplement a compound.

Methods of application:

Supplementary muriate of potash: broadcast and ploughed in during preceding autumn.

Potatoes: N,P,K and FYM broadcast before working down seedbed for 1st test crop 1968-70.

NOTE: To 1961 FYM was applied in spring over the ridges.
1962-68 FYM was ploughed down in the autumn for 2nd test crop.
(In 1968 potatoes were taken as both 1st and 2nd test crops)

Cereals: P and K combine drilled. N top-dressed
Sugar beet: N, P, K broadcast before working down seedbed.
First year leys: Standard dressings broadcast and harrowed into seedbed, top-dressed by hand after cutting.
Other leys: PK applied by drill in autumn, top-dressed by hand in spring and after cutting.

Varieties of arable crops

- | | | |
|------------------|----------------|--|
| (a) Potatoes | 1968 | Second test: Majestic, Irish A chitted |
| | 1968 | First test: King Edward, Irish A chitted |
| | 1969-70 & 1973 | King Edward paracrinkle free, once grown, chitted. |
| | | |
| (b) Winter wheat | 1968 | Cappelle |
| | 1969-72 | Joss Cambier |
| | 1973 | Cappelle |
| (c) Barley | 1968-69 | Maris Badger |
| | 1970 | Julia, dressed with carboxin |
| | 1971 | Julia |
| | 1972 | Julia, dressed with ethirimol |
| (d) Sugar beet | 1968 & 1972 | Klein E |
| (e) Oats | 1968 & 1969 | Manod |

Seeds mixtures for leys

- (a) H, undersown in barley 1970, sown without a cover crop autumn 1972:
Perennial ryegrass S.24: 64% Red Clover S.123: 29%
Canadian Alsike: 7% Mixture sown at 31 kg
- (b) Ln, sown without a cover crop spring 1970 and 1973:
Timothy S.51: 45% Meadow Fescue S.215: 55%
sown at 37 kg in 1970, 33 kg in 1973.
- (c) Lc, 1970 and 1973; Rn, Rc 1973, sown without a cover crop in spring:
Timothy S.51: 42% Meadow Fescue S.215: 50%,
White clover S.100: 8%. Sown at 38 kg.
- (d) Lucerne, sown spring 1970 and 1973:
1970 Du Puits sown at 28 kg. 1973 Europe sown at 28 kg.

Management of grass and leys

As for the third period 1961-67 (*Details 1967*, p. 87) except for the one year ley (H) which was cut four times in 1971 while in 1973 it was cut twice. All leys, also R and G where applicable, were ploughed in the autumn before the first test crop in the following year, except the Lucerne in 1969 which was ploughed in July for a short fallow.

Weedkillers

Wheat and Barley	1968 & 1969	2, 4-D with mecoprop
Wheat	1970/71	2, 4-D with dichlorprop
Barley	1970	2, 4-D with dichlorprop
Barley undersown	1970	MCPA with MCPB
Barley	1971	Ioxynil with mecoprop
Wheat	1972/73	Dicamba, with mecoprop and MCPA
Barley	1972	Bromoxynil, ioxynil, dichlorprop and MCPA
Oats	1969	Ioxynil with mecoprop
Potatoes	1968-70 & 1973	Paraquat with linuron
First year leys	1970	MCPA with MCPB
First year leys	1973	Benazolin, 2, 4-DB and MCPA
Lucerne	1973	2, 4-DB and MCPA

Soil series

Highfield:	Batcombe series
Fosters:	Batcombe series with small areas of sandier soil.

Reference

1. Johnston, A.E. (1973)
The effect of ley and arable cropping systems on the amount of soil organic matter in the Rothamsted and Woburn ley-arable experiments. *Rothamsted Experimental Station. Report for 1972, Part 2, 131-159.*