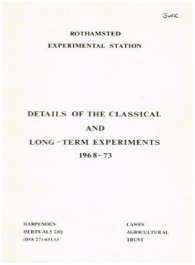
Details of the Classical and Long-term Experiments 1968-73



Full Table of Content

Modern Long-term Experiments

Rothamsted Research

Rothamsted Research (1977) *Modern Long-term Experiments ;* Details Of The Classical And Long-Term Experiments 1968-73, pp 36 - 77 **- DOI: https://doi.org/10.23637/ERADOC-1-193**

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 K_2O 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 P_2O_5 and 1.2 cwt K_2O 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 K_2O 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_2O_5	K_2O	P_2O_5	K_2O	P_2O_5	K_2O
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*

https://doi.org/10.23637/ERADOC-1-193 *pp 2*

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

Symbols:

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.

https://doi.org/10.23637/ERADOC-1-193

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_2O_5 and K_2O)

	Lu		L,R,G		A	
	P_2O_5	K_2O	P_2O_5	K_2O	P_2O_5	K_2O)
First	75	75	75	150	75	75 + 75 after each cut except the last. (Note 2).
Second	115	230	75	150 (see Note 1)	125	300
Third	115	230	75	150 (see Note 1)	38	75

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_2O	for each cut
1970–	R,G,2L,3L	48 kg K_2O	for each cut
1970 & 1973	1L	48 kg K_2O	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 K_2O 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_2O_5, 75 kg K_2O
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).

https://doi.org/10.23637/ERADOC-1-193 *pp 4*

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

PHASE	A			B			C			D			E			F		
Rotation	Lu,Lc Ln,A	R	G	Lu,Lc Ln,A	R	G	Lu,Lc Ln,A	R	G	Lu,Lc Ln,A	R	G	Lu,Lc Ln,A	R	G	Lu,Lc Ln,A	R	G
1962	P	R	G c-n	Tr2	R	G c-n	W	R	G c-n	Tr1	R	G c-n	Tr3	R	G c-n	B	R	G c-n
1963	B	R c-n	G c-n	Tr3	R	*G c-n	P	R c-n	G c-n	Tr2	R	G c-n	W	W	G c-n	Tr1	R c-n	G c-n
1964	Tr1	R c-n	G c-n	W	W	*G c-n	B	R c-n	G c-n	Tr3	R	G c-n	P	P	G c-n	Tr2	R c-n	G c-n
1965	Tr2	R c-n	G c-n	P	P	G c-n	Tr1	R c-n	G c-n	W	W	G c-n	B	B	G c-n	Tr3	R c-n	G c-n
1966	Tr3	R c-n	G c-n	B	B	G c-n	Tr2	R c-n	G c-n	P	P	G c-n	Tr1	H	G c-n	W	R c-n	G c-n
1967	W	R c-n	G c-n	Tr1	H	G c-n	Tr3	R c-n	G c-n	B	B	G c-n	Tr2	S	G c-n	P	R c-n	G c-n
1968	P	R c-n	G c-n	Tr2	S	G c-n	P	P		WHEAT			Tr3	0	G c-n	B	R c-n	G c-n
1969	B	R c-n	G c-n	Tr3	O	G c-n	W	W		WHEAT			P			WHEAT		
1970	Tr1+B†	R c-n	G c-n	P	P	G c-n	B	B		WHEAT			W			WHEAT		
1971	Tr2+H	R c-n	G c-n	W	W	G c-n	WHEAT			WHEAT			B			WHEAT		
1972	Tr3+SB	R c-n	G c-n	B	B	G c-n	WHEAT			WHEAT			WHEAT			WHEAT		
1973	P	R c-n	G c-n	Tr1	R c-n	G c-n	WHEAT			WHEAT			WHEAT			WHEAT		

† See Note 1. * See Note 2.

(a) Supplementary K dressings (kg $K_2 0$) 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 corrected	—
Gn	—	—	—	440	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
$P_2 0_5$ (1/16 plots)	0.v. 115	190+	55	No FYM 245 v. 360
$K_2 0$ (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

https://doi.org/10.23637/ERADOC-1-193

No P and K test, standard only at 300 kg P_2O_5 and 300 kg K_2O
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 P_2O_5 plus 50 kg K_2O ploughed down
63 kg P_2O_5 plus 63 kg K_2O combine drilled

(iii) *Wheat as fourth and subsequent test crop:*

1968	N test (Highfield)	38v. 75 v. 115 v. 150 kg N
	on ¼ plots (Fosters)	50 v. 100 v. 150 v. 200 kg N
	Standard dressings	115 kg P_2O_5 and 115 K_2O 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_2O_5, 50 kg K_2O ploughed down 63 kg P_2O_5, 63 kg K_2O combine drilled
1971-73	N as 1969-70	
	Standard dressings	75 kg P_2O_5, 75 kg K_2O 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 P_2O_5 and 75 K_2O
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.

https://doi.org/10.23637/ERADOC-1-193

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.

https://doi.org/10.23637/ERADOC-1-193 *pp 8*

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.

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LEY-ARABLE ROTATION
WOBURN, STACKYARD FIELD
(W/RN/3)

This experiment, which was started in 1938, was designed to test the effects on soil fertility of a three-year grazed ley, three years of lucerne and a three course arable rotation including one year hay in comparison with a rotation without leys measured by the yields of two successive test crops. *(Details 1967,* pp. 105-114).

Large differences in the yields of potatoes grown in contrasting conditions in 1966 led to the introduction of a number of studies in soil pathogens. Initially the tests were applied to the treatment crops of potatoes but in 1971 potatoes were re-introduced as the first test crop. A number of other changes were made including the substitution of S123 red clover for sainfoin which had often failed to survive three years. These are summarised below and set out in detail in table 2.

Treatment crops

	1st year	2nd year	3rd year
Ley (L)	Grazed to 1968 Cut from 1969	Grazed to 1968 Cut from 1969	Grazed to 1969 Cut from 1970
Sainfoin (cut) (S)	Till 1971	Till 1971	Till 1971
S123 Clover (cut (C1))	1972–	Sown July 1971	Sown July 1971
Arable (roots) (A)	Potatoes (P)	1968-71 Rye (R) 1972 – Barley (B)	1968-71 Carrots (C) 1972 – Barley
Arable (hay) (AH)	Potatoes	1968-71 Rye 1972 – Barley	Hay* (H)

*the seeds were undersown in the preceding cereals in some seasons.

Test crops

	1st	2nd
1968-70	Barley	Barley
1971	Potatoes	Barley
1972 & 1973	Potatoes	Wheat

Treatments

(i) *Potatoes*

(a) *Treatment crops*

1968 None v. thiram (approx. 8 kg a.i.) applied to tuber

NOTE: Thiram-dressed seed was chitted, untreated seed was not chitted (on 1/24 plots)

1968-70 (a) None v. 448 kg chloropicrin (on ¼ plots)
(b) 125 v. 188 v. 251 kg N (on 1/12 plots)

1969 & 1970 None v. 11 kg aldicarb (on 1/24 plots)

1972 None v. 448 kg chloropicrin plus 5.6 kg aldicarb (on 1/4 plots)

https://doi.org/10.23637/ERADOC-1-193 *pp 10*

1973 None v. 448 kg chloropicrin plus 6.7 kg aldicarb (applied also in error to the 1/4 plots of the 1st year ley and 1st year clover on 'alternating' rotations.

(b) *Test crops* (Note: FYM no longer applied to test crop)

1971 None v. 448 kg chloropicrin plus 11.2 kg aldicarb
Varieties: Maris Piper v. Pentland Crown
On 1/2 plots after ley and sainfoin and 1/4 plots after arable and arable with ley (1971 only; other years Maris Piper only).

1972 & 1973 None v. 448 chloropicrin plus:
1972 5.6 kg aldicarb,
1973 6.7 kg aldicarb.

(ii) *Other test crops*

(a) Barley as first test crop 1968-70 (on 1/8 plots) after A and AH rotations: 50 v. 100 v. 150 v. 200 kg N. After L and S rotations: 0 v. 50 v. 100 v. 150 kg N.

(b) Wheat as second test crop 1972 and 73. (on 1/8 plots) 0 v. 63 v. 126 v. 188 kg N.

Residual effects of the farmyard manure applied prior to 1968 and of fumigants from 1968 have been tested in a number of crops as shown in Table 2.

Table 2
Cropping Sequences and Residuals Tested

Phase 1

		Continuous			Alternating rotations			
1967	L1	S1	P	P	P	P	L1	S1
1968	L2	S2+	R+	R+	R+	R+	L2	S2+
1969	L3	S3	H	C	H	C	L3	S3
1970				BARLEY+				
1971				BARLEY				
1972	L1	Cl1	P*+	P*+	Cl1	L1	P*+	P*+
1973	L2	Cl2	B+F	B+F	Cl2	L2	B+F	B+F

NOTES: (1) FYM at 38 t last applied to 1st test crop (Sugar beet) 1965
Residual effect measured in crops marked (+)
(2) Fumigant test applied to potato crops (*)
Residual effect measured in crops marked (F)

Phase 2

		Continuous			Alternating rotations			
1967	L2	S2	R	R	R	R	S2	L2
1968	L3	S3+	H+	C+	C+	H+	S3+	L3
1969				BARLEY+				
1970				BARLEY				
1971	L1	S/C1	P+	P+	S/C1	L1	P+	P+
1972	L2	C12	B	B	C12	L2	B	B
1973	L3	C13	H	B+	C13	L3	B+	H

NOTES: (1) FYM at 38 t last applied to 1st test crop (Sugar beet) 1964
Residual effect measured in crops marked (+)

https://doi.org/10.23637/ERADOC-1-193 *pp 11*

Phase 3

	Continuous			Alternating rotations			
1967			BARLEY				
1968	L1	S1+	P*	P*	S1+	L1	P*	P*
1969	L2	S2	R+F	R+F	S2	L2	R+F	R+F
1970	L3	S3	H	C+F	S3	L3	H	C+F
1971				POTATOES+*				
1972				WHEAT+F				
1973	L1	C11	P*+	P*+	P*+	P*+	C11	L1

NOTES: (1) FYM at 38 t last applied to 1st test crop (Sugar beet) 1966
Residual effect measured in crops marked (+)
(2) Fumigants applied to potatoes (*)
Residual effect measured in crops marked (F)

Phase 4

	Continuous			Alternating rotations			
1967	L3	S3	H	C	H	C	L3	S3
1968				BARLEY+				
1969				BARLEY				
1970	L1	S1	P*+	P*+	S1	L1	P*+	P*+
1971	L2	S2/C1	R+F	R+F	S2/C1	L2	R+F	R+F
1972	L3	C13	H	B	C13	L3	B	H
1973				POTATOES*+				

NOTES: (1) FYM at 38 t last applied to 1st test crop (Sugar beet) 1963
Residual effect measured in crops marked (+)
(2) Fumigants applied to potatoes (*)
Residual effect measured in crops marked (F)

Phase 5

	Continuous			Alternating rotations			
1967				SUGAR BEET				
1968				BARLEY+				
1969	L1	Sl	P*+	P*+	S1	L1	P*+	P*+
1970	L2	S2	R+F	R+F	S2	L2	R+F	R+F
1971	L3	S3	H	C+F	S3	L3	C+F	H
1972				POTATOES*+				
1973				WHEAT+F				

NOTES: (1) FYM at 38 t last applied to 1st crop (Sugar beet) 1967
Residual effect measured in crops marked (+)
(2) Fumigant test applied to potato crops (*)
Residual effect measured in crops marked (F)

Standard manurial dressings (kg)

Treatment crops

	N	P_2O_5	K_2O	Material	Application
Potatoes					
1968-70	–	115	225	(0-14-28)	On the flat
1971–	251	251	387	(13-13-20)	On the flat

https://doi.org/10.23637/ERADOC-1-193 *pp 12*

Rye					
1968	75	40	75	'N-Chalk, & (0-14-28)	Top-dressed combine drilled
1969–	40	40	75	'N-Chalk' & (0-14-28)	Top-dressed combine drilled
Barley					
1972–	63	63	63	(15-15-15)	Combine drilled
Carrots					
1968-71	75	75	225	'N-Chalk', Super & Muriate	Seedbed
One year ley (hay)					
1968	125	75	150	'N-Chalk' & (0-14-28)	In spring
	75	–	75	(16-0-16)	After 1st cut
1969-73	Spring dressing as 1968				
	75	–	50	(25-0-16)	After 1st cut
Ley–first year					
1968-73	50	188	125	'N-Chalk', Super & Muriate	Seedbed
1968 (grazed)	75	–	75	(16-0-16)	1 top dressing
1969, 1970, 1972 & 1973 (cut)	100	–	63	(25-0-16)	2 dressings
1971 (cut)	50	–	32	(25-0-16)	1 dressing
	N	P_2O_5	K_2O	Material	Application
Ley-second & third years					
1968 (cut) 2nd year	100	–	100	(16-0-16)	2 dressings
1969 (cut) 3rd year	100	--	63	(25-0-16)	2 dressings
1969 (grazed) 2nd & 3rd year	150	–	93	(25-0-16)	3 dressings
1970-73 (cut)	150	–	93	(25-0-16)	3 dressings
Sainfoin 1st year					
1968-71	63	188	126	'N-Chalk', Super & Muriate	Seedbed
2nd & 3rd year					
1968-71	63	–	188	'N-Chalk' & Muriate	1 dressing
Clover					
1st year 1972	63	188	126	'N-Chalk,' Super & Muriate	To Seedbed
2nd & 3rd years					
1972–	63	–	188	'N-Chalk' & Muriate	1 dressing

Magnesium sulphate (as Epsom salts) was applied to first treatment crops in the seedbed:–

1968 and 1969	620 kg (62 kg Mg)
1970	375 kg (37 kg Mg) – the smaller quantity applied in error.

https://doi.org/10.23637/ERADOC-1-193

Test crops	N	P_2O_5	K_2O	Material	Application
Barley – 1st test					
1968-70	–	63	63	(0-20-20)	Seedbed
Barley – 2nd test					
1968	75	40	0	'N-Chalk' & Super	Seedbed
1969-71	63	63	63	(15-15-15)	Seedbed
Potatoes – 1st test					
1971-73	250	250	385	(13-13-20)	Seedbed
Wheat – 2nd test					
1972-73		60	60	(0-20-20)	Seedbed

Table 3

Corrective K dressings (kg K_2O) applied to first test crop as muriate of potash, half before ploughing and half after

Continuous rotations	1968		1969		1970		1971		1972		1973	
	O	D	O	D	O	D	O	D	O	D	O	D
Leys (L)	0	126	188	0	200	0	126	126	251	251	502	502
Sainfoin (S) (Clover from 1972 (C1))	377	377	439	314	439	377	126	126	0	0	126	126
Arable with hay (AH)	628	502	502	439	628	628	188	188	314	251	314	376
Arable (A)	251	251	377	377	377	251	0	0	314	314	439	439

Alternating rotations (Last two rotations in order)

	1968			1969			1970	
	O	D		O	D		O	D
AH/L	0	63	A/L	251	251	AH/L	251	63
A/S	628	377	AH/S	377	251	A/S	439	314
L/AH	628	377	LU/AH	502	502	L/AH	502	502
LU/A	628	377	L/A	377	377	LU/A	439	439

	1971			1972			1973	
	O	D		O	D		O	D
A/L	188	439	A/L	439	376	L/A	439	439
AH/S	126	126	H/C1	126	126	S/AH	439	502
L/AH	63	63	L/AH	251	251	A/L	502	502
S/A	188	314	C/A	376	376	AH/C	251	0

O = No FYM half plots D = FYM half plots

Liming

Lime was applied in the autumn to the plots intended for the second test crop.

https://doi.org/10.23637/ERADOC-1-193 *pp 14*

1968	Ground Magnesium limestone at 5.6 t
1969	Ground Magnesium limestone at 5.0 t
1970	Ground Chalk at 5.0 t
1971-73	Ground Magnesium limestone at 5.0 t

Varieties

1968-70	Common Sainfoin	Maris Badger Barley	Maris Piper Potatoes	King II Rye	Autumn King Carrots
1971	S.123 Red Clover	Julia Barley	Maris Piper* Potatoes	King II Rye	Autumn King Carrots
1972 & 1973	S.123 Red Clover	Julia Barley	Maris Piper Potatoes	Capelle Wheat	

* Pentland Crown was also grown in the test crop plots.

Seeds mixtures

Hay 21 kg S.24 Perennial ryegrass,
10 kg Late flowering Red clover, 2 kg Alsike clover

Ley 22 kg S.23 Perennial ryegrass, 12 kg S.143 Cocksfoot,
7 kg Late flowering Red clover, 3 kg S.100 White clover.

Soil series Cottenham and Flitwick.

Reference

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

https://doi.org/10.23637/ERADOC-1-193 *pp 15*

MARKET GARDEN
WOBURN LANSOME I
(W/RN/4)

The study of the effects of bulky organic materials, mainly on Market Garden crops over the period 1942-1967 are described in *Details 1967*, pp. 115-122. Tick beans were grown in 1968 and 1969 without further treatment and since then farm crops have been grown for a study of direct and residual effects of phosphate on the same site.

Corrections and additions to the 1967 report are:

(a) p.118 Table 58. Symbols and treatments 1964 should read: N1 = 0.45, N2 = 0.9 cwt for carrots; N1 = 0.90, N2 = 1.8 cwt for red beet and leeks as 'Nitro-Chalk'.

(b) Same Table 1965: Add Series A carrots 0.45 N v. 0.90 cwt N as 'Nitro-Chalk'.

(c) Same Table 1967: Series B should read Quarter in place of Eighth plots.

(d) The following additional note should be added at the foot of the table:

(6) $N' = N_3 + N_2 - N_1 - N_0$
$N'' = N_3 - N_2 - N_1 + N_0$
$N''' = N_3 - N_2 + N_1 - N_0$

(e) substitute the following for the paragraph on Liming on p 120:

Liming

From 1943 to 1945 ground chalk at 29 cwt/acre was applied before planting cabbages. From 1948 to 1951 attempts were made to correct the acidity developed due to the application of sulphate of ammonia. A uniform dressing of chalk was given to all plots: Series A: 11 cwt in 1948 and 22 cwt in 1950. Series B: 22 cwt in 1949 and a few plots received further small dressings in 1951. From 1952 to 1967 20 cwt of ground chalk was given before every crop of red beet with the following exceptions:

(i) In 1955 this was applied to spring cabbages also.
(ii) From 1958 the quantity was increased to 23 cwt except 1963 when 20 cwt was applied.
(iii) No chalk was applied in 1965.
(iv) In 1967 40 cwt of ground chalk was applied to 16 only of the 40 plots in Series B used for fertiliser and continuous FYM experiment.

Cropping

	Series A	Series B
1968 and 1969	Beans	Beans
1970	Sugar beet	Barley
1971	Barley	Potatoes
1972	Potatoes	Sugar beet
1973	Barley	Barley

No yields were taken in 1973 because of bird damage.

https://doi.org/10.23637/ERADOC-1-193 *pp 16*

Treatments

No fresh treatments were applied in 1968, 1969 and 1973.

Barley 1970 and 1971	0 v. 63 kg $P_2 0_5$
Sugar beet 1970 and 1972	0 v. 126 kg $P_2 0_5$
Potatoes 1971 and 1972	0 v. 188 kg $P_2 0_5$

Applied to whole plots with confounding of certain two and three factor interactions.

Basal manuring (kg/ha)

Beans 1968 and 1969	None		
Sugar beet 1970	190 N	320 $K_2 0$	100 Mg0
1972	190 N	500 $K_2 0$	95 Mg0

Boron was applied as a spray in June 1972 – 6.7 $B_2 0_3$

Barley 1970 and 1971	63 N	63 $K_2 0$	
1973	70 N		
Potatoes 1971	250 N	250 $K_2 0$	100 Mg0
1972	250 N	250 $K_2 0$	100 Mg0

Materials: Superphosphate, muriate of potash, Epsom Salts and 'Solubor'.

Liming

1969	Series A:	2.8 t ground magnesian limestone
	Series B:	5.6 t ground magnesian limestone
1970-72	2.5 t ground chalk	

Weedkillers

Beans 1968	Simazine
1969	Paraquat and simazine
Barley	Ioxynil with mecoprop
Sugar beet	Phenmedipham
Potatoes 1971	Linuron
1972	Linuron with paraquat

Other sprays

Beans	Demeton-S-methyl
Sugar beet	Demeton-S-methyl
Potatoes	Mancozeb and demeton-S-methyl

Varieties

Beans	Tarvin
Barley	Julia (dressed with ethirimol 1973)
Sugar beet	Klein E
Potatoes	Pentland Crown

Areas harvested

1968 and 1969	Beans 0.00166
1970	Sugar beet 0.00162 – Barley 0.00073
1971	Barley and potatoes – 0.00074
1972	Potatoes 0.00147 – Sugar beet 0.00127

Soil series Cottenham

https://doi.org/10.23637/ERADOC-1-193 *pp 17*

References

1. Johnston, A.E. and Wedderburn, R.W.M. (1975)
The Woburn Market Garden Experiment, 1942-69. I. A history of the experiment, details of the treatments and the yields of the crops.
Rothamsted Experimental Station. Report for 1974, Part 2, 79-101.

2. Johnston, A.E. (1975)
The Woburn Market Garden Experiment 1942-69. II. The effect of the treatments on soil pH, soil carbon, nitrogen, phosphorous and potassium.
Rothamsted Experimental Station. Report for 1974, Part 2, 102-130.

3. Johnston, A.E., Mattingley, G.E.G., and Poulton, P.R. (1976)
Effect of phosphate residues on Soil P values and crop yields. I. Experiments on barley, potatoes and sugar beet on sandy loam soils at Woburn.
Rothamsted Experimental Station. Report for 1975, Part 2, 5-35.

https://doi.org/10.23637/ERADOC-1-193 *pp 18*

RESIDUAL PHOSPHATE

ROTHAMSTED, GREAT FIELD IV AND SAWYERS I

(R/RN/7)

The crop rotation and phosphate manuring programmes for the second period 1967-72 *(Details 1967,* p.89) have been followed. In 1973 the rotation was continued for one more year before changes in 1974, and the treatments were slightly altered on metrication in 1973.

NOTE: The potash applied as a basal manure is the sulphate, not the muriate as stated on p. 90 *(Details 1967).*

Treatments (all as granular superphosphate kg P_2O_5/ha)

Symbol	Frequency	Total 1967-72	1973
0	None	–	0
A1	Annual	188*	29*
A2	Annual	377*	57*
A3	Annual	753*	115*
A4	Annual	1130*	172*
T1	1969, 1972	188*	–
T2	1969, 1972	377*	–
R2	1967	377°	344+
R3	1967	753°	688+
R4	1967	1130°	1032+
G1	None since		
S1	1960		

For details of manuring during the first period 1960-65 and the fallow of 1966 see *Details 1967,* pp 88-89.

* applied in seedbed
\+ half applied in autumn before ploughing and half in spring before cultivation
o half applied in June and half in September 1966 and worked into fallow

Basal dressings (kg/ha)
Broadcast in spring before sowing or planting as 'Nitro-Chalk' and sulphate of potash; except for barley since 1970 as (25-0-16) combine drilled.

		N	K_2O
Barley:	1968-69	50 Great Field	126
		100 Sawyers	126
	1970–	100	63
Potatoes:	1968-69	150	188
	1970–	251	251
Swedes:	1968-73	63	126

Liming
Ground chalk applied before ploughing in autumn to land to be cropped with barley t/ha

1968	None
1969	2.9

https://doi.org/10.23637/ERADOC-1-193 *pp 19*

	1970-71	3.1
	1972	2.9
	1973	None

Varieties

Barley:	1968-69	Maris Badger
	1970-73	Julia (dressed with ethirimol 1972 and 1973.)
Potatoes:	Majestic, chitted seed:	
	1968	Irish A
	1969-71	Once grown
	1972	Scotch
	1973	Foundation Stock
Swedes:	1968-73	Wilhelms dressed with Gamma-BHC with captan (1970 Green Globe turnips were sown in place of swedes which failed)

Weedkillers

Barley:	1969-70	2,4-D with dichloroprop
	1971-72	Ioxynil, bromoxynil with dichloroprop
	1973	Dicamba, mecoprop with MCPA
Potatoes:	1968	Paraquat with linuron
Swedes:	1972	Paraquat to previous barley stubble

Other chemicals applied

Potatoes:	1968	Mancozeb and demeton-S-methyl
	1968–	Sulphuric acid (BOV) to burn off tops

Areas harvested

	Great Field IV	Sawyers I
Barley and potatoes:	0.00520	0.00572
Swedes:	0.00390	0.00429

Soil series

Great Field	Batcombe series
Sawyers I	Batcombe series with sandier variants.

https://doi.org/10.23637/ERADOC-1-193 *pp 20*

CULTIVATION – WEEDKILLER

ROTHAMSTED GREAT HARPENDEN I

(R/RN/8)

The Rothamsted experiment has been continued, up to 1972 as set out in *'Details 1967,* pp. 91-94. Winter wheat was grown each year except 1971 when this crop was spring-sown and spring beans were grown throughout. From 1973 only one phase of the rotation is maintained each year, starting with winter wheat to be followed by potatoes, barley, spring beans.

Treatments (from 1961 unless stated otherwise)

(1) *Whole plots.* All combinations of:

(i) Primary cultivation for each crop by: mouldboard plough (P), rotary cultivator (R), deep-tine cultivator (T).

(ii) Post planting weed-control in beans and potatoes: mechanical (no weedkiller) (M), persistent weedkiller with little or no cultivation (SX), persistent weedkiller (SY) (differing from SX in material, time of application or subsequent cultivation).

(2) *'Reserve plots'* have been used in addition:

(a) (Since 1964) for spring sown crops, no culivation in autumn or winter, rotary cultivated before sowing; for autumn sown crops: as treatment P. These crops are sprayed as X.

(b) (Since 1966) all crops receive the minimum cultivations necessary to produce a seedbed. Details vary according to conditions and paraquat may be used at any stage in the rotation (see below). These crops are sprayed as X and cereals treated as H sub-plots. Since 1969 the cereal straw has been burnt and bean straw raked off as there has been insufficient to burn.

(c) (Since 1969). 'Standard cultivations' applied where primary cultivations considered best for the crop are used:

Potatoes:	plough in autumn, rotary cultivate in spring, weedkiller and rotary ridging as SY plots.
Barley:	deep time cultivate, treat with same weedkiller as H plots.
Beans:	plough, weedkiller as SX plots.
Wheat:	plough or deep-tine cultivate, treat with same weedkiller as H sub-plots.

NOTE: Herbicide treatments on wheat and barley were omitted in 1969 on C plots.

(3) *Half-plots.*

Weed control in wheat and barley: no spray (0) v. post emergence herbicide (H).

(Since 1968) 0 v. paraquat (G) applied to stubbles after beans, wheat and barley applied cumulatively on half plots.

Rates: 1968-71 0 v. 0.84 kg ion

1972 & 73 0 v. 0.56 kg ion

https://doi.org/10.23637/ERADOC-1-193 *pp 21*

NOTE: (i) Paraquat at 1.68 kg ion applied to all bean stubbles in September 1970 instead of to half plots.
(ii) the interaction (0 v. H) x (0 v. G) is confounded with the block difference in each series.

Treatments from 1973

One series only is retained, and the treatments are continued except for reserve plots A, B and C which are now:

Whole plots	A	Spike rotary cultivated direct on stubble
	B	Shallow ploughed
	C	Standard farm practice
Half plots	A and C test (0 v. H) (0 v. G)	
	B tests (0 v. H) with basal G.	

Weedkillers used 1968-73

(a) Persistent weedkillers for beans and potatoes (a.i./ha)

	Beans		Potatoes
1968 & 1969	Simazine 1.1 kg		Linuron 0.84 kg with paraquat 0.42 kg ion.
1970	Simazine 1.1 kg		Linuron 1.68 kg
	SX,A,B,C, plots	SY plots	
1971	Simazine 1.1 kg	Dinoseb acetate 2.8 kg	Linuron 0.84 kg with paraquat 0.84 kg ion
1972	Simazine 1.1 kg	Dinoseb acetate 2.8 kg	Linuron 0.84 kg with paraquat 0.42 kg ion

(b) Non-persistent weedkiller to wheat and barley (H sub-plots, B and C reserve plots)

	Wheat	Barley
1968 & 1969	Mecoprop with 2,4-D. (9.8 l 'Methoxone Extra')	Mecoprop with 2,4-D (8.4 l'Methoxone Extra')
1970	Mecoprop with 2,4-D (6.3 l 'Methoxone 4X')	Mecoprop with 2,4-D (5.6 l 'Methoxone 4X')
1971	Ioxynil at 0.84 kg with 2.52 kg mecoprop	Ioxynil at 0.84 kg with 2.52 kg mecoprop
1972 & 1973	Ioxynil at 0.63 kg with 1.90 kg mecoprop	Ioxynil at 0.53 kg with 1.60 kg mecoprop

(c) Weedkillers applied in autumn and winter:

1967-69	Sodium trichloroacetate (40 kg split dressing) before barley.
1969-70	Paraquat (0.84 kg) before wheat, beans, potatoes on B plots.
1970-71	Paraquat (0.84 kg) before beans and potatoes on B plots. (See above re treatment of bean stubble before wheat)
1971-72	Sodium trichloroacetate (40 kg split dressing) before barley. Paraquat (0.56 kg) before wheat, beans, potatoes on B plots.

https://doi.org/10.23637/ERADOC-1-193 *pp 22*

NOTE: The rates for certain weedkillers given above differ from those given in the reference and should be taken as the correct ones.

Standard manuring kg/ha

Beans	1968-72	(0-14-28) at 410
Potatoes	1968-72	(13-13-20) at 1250
Barley	1968-72	(25-10-10) at 377
Wheat	1968 & 1969	(6-15-15) at 314 plus 75 N
	1970	(8-20-) at 235 plus 75 N
	1971	(25-10-10) at 377
	1972	(10-24-24) at 251 plus 75 N
	1973	(10-24-24) at 251 plus 95 N

Liming

Ground chalk t/ha applied autumn 1967

Beans 2.9 Wheat and potatoes 5.8 Barley 11.6

Varieties

Beans	1968 & 1969	Maris Bead
	1970	Maris Bead
	1971	Maris Bead
	1972	Maris Bead
	1973	—
Wheat	1968 & 1969	Capelle
	1970	Capelle
	1971	Kolibri
	1972	Cappelle
	1973	Bouquet
Potatoes	1968 & 1969	Pentland Dell Irish A.
	1970	Pentland Dell Once grown
	1971	Pentland Crown Irish A
	1972	Pentland Crown Once grown
	1973	—
Barley	1968 & 1969	Maris Badger
	1970	Julia
	1971	Julia
	1972	Julia (dressed with ethirimol)
	1973	—

Other Chemicals to beans and potatoes

	Beans	Potatoes
1968	—	Mancozeb and Demeton-S-methyl Tops burnt off with B.O.V.
1969-71	Demeton-S-methyl	Mancozeb and Demeton-S-methyl, B.O.V.
1972	Phorate	Mancozeb and Demeton-S-methyl, B.O.V.

Areas harvested

Beans 0.00405 – 0.00488 Wheat & Barley 0.00434

Potatoes 0.00217 – 0.00434

Soil series

Shallow Batcombe and Batcombe series with small area of Charity complex.

https://doi.org/10.23637/ERADOC-1-193 *pp 23*

Reference

1. Moffatt, J.R. (1975)
Cultivation weedkiller Experiment, Rothamsted, 1961-72.
Rothamsted Experimental Station. Report for 1974, Part 2, 155-170

Cultivation Weedkiller Experiment

Two statements regarding treatments applied included in the article in the *Report for 1974,* Part 2, appear to conflict with the records in the White Book.

1. Page 157
'in all years from 1965, except 1969 and 1970, the ground after potatoes for barley was sprayed with TCA at 20 lb/acre . . . . . In 1966 the bean stubble was sprayed with aminotriazole at 2 gal/acre in 40 gal.'

The rates recorded were 'Tecane at 20 lbs per acre on two occasions each year. Tecane is reported to contain 90% acid equivalent i.e. approx. twice amount mentioned in the article was applied. The material applied to the bean stubble was 'Weedazol T-L' at 2 gal/acre. 2 gal contains 4 lb aminotriazole and 3.7 lb ammonium thiocyanate *'Results 1967'* and *'Details 1967'* Table 43. So the statement should refer to the material used or the rate should be altered.

2. Page 161
'The herbicides used were:

1964-65	linuron (2 lb/acre) plus paraquat (0.75 lb/acre)
1966-68	linuron (1 lb/acre) plus paraquat (0.37 lb/acre)
1969-72	linuron (1 lb/acre) plus paraquat (0.75 lb/acre)'

The statement for 1964-65 agrees with the records for the SY plots but does not mention the SX plots which received 2 lb prometryne plus 0.75 lb paraquat. *(Details 1967,* Table 41).

The applications recorded in the White Book are:

Year	Product	Active materials
1966 & 1967	3 pints Gramoxone W	0.75 lb paraquat
	+ 2 lb linuron 50	1 lb linuron
1968 & 1969	1½ pints Gramoxone W	0.37 lb paraquat
	+ 1½ lb linuron 50	0.75 lb linuron
1970	3 lb linuron 50	1.5 lb linuron
1971	3 pt. Gramoxone W	0.75 lb paraquat
	1½ lb linuron 50	0.75 lb linuron
1972	1½ pt Gramoxone W	0.37 lb paraquat
	1½ pt linuron 50	0.75 lb linuron

There are therefore some differences from the amounts in the article in all these years.

https://doi.org/10.23637/ERADOC-1-193 *pp 24*

ORGANIC MANURING

WOBURN STACKYARD B

(W/RN/12)

The experiment was designed to test the effects of several different forms of organic matter applied to the light poorly-structured soils at Woburn. An initial period (1965 to 1971 or 1972) in which organic matter was added by leys, green manures or organic materials applied to arable crops, is being followed by an arable rotation in which effects are tested without further additions. (For further details see Ref 1)

Treatments

(a) *Organic*

(Lc)	Grass-clover ley, N to seedbed only
(Ln)	All grass ley, N for each cut
(St)	Barley straw, chopped except in 1970, at 7.5 t dry matter annually
(Pt)	Sedge peat at 7.5 t dry matter annually
(Gm)	Green manures as practicable depending on arable crop grown
(Fs)	No organic matter
(Dg)	Farmyard manure at about 50 t fresh weight per annum (25 t in 1967 and 1970)
(Fd)	No organic matter but P, K and Mg equivalent to that in FYM applied

NOTES: 1. Treatments other than Dg and Fd received the same total amounts of PKMg either as fertilisers alone (Fs) or as fertiliser additions to the organic manures. The amounts were equal to the PK and Mg in the barley straw plus an amount of superphosphate to bring the total phosphate to 63 kg P_2O_5 per ha.

2. Annual balancing dressings of PKMg were applied retrospectively to allow for differential removals by crops.

3. Full details of the PKMg applied in accordance with 1. and 2. are given in Appendix I of reference I.

4. An outline of the treatments and of the cropping programme are set out in Table 4.

(b) *Nitrogen*

(i) Tests in the initial period. N was applied at four equally spaced levels to the first four crops, the dressings being rotated to avoid differential effects:–

Year	Crops	N rates (kg/ha)			
1966	Barley	0	25	50	75
1967	Potatoes				
1968	Winter wheat	25	75	125	175
1969	Sugar beet				

(ii) 1972 & 1973 Potatoes (Blocks I and III 1972: II and IV 1973)
0, 50, 100, 150, 200, 250, 300, 350 kg N

https://doi.org/10.23637/ERADOC-1-193 *pp 25*

(iii) 1973 Wheat (Blocks I and III)
0, 25, 50, 75, 100, 125, 150, 175 kg N

(c) *Green manuring* – Details of cropping

1964 Hybrid Italian ryegrass sown in spring but rotavated in July owing to weed infestation

1965 Hybrid Italian ryegrass sown in spring and ploughed in September

1966 Trefoil was undersown in wheat in November and again in the barley, which replaced the wheat in April. This was ploughed up at the end of November

1968 Late flowering red clover undersown in winter wheat in March and ploughed in at the end of November

1971 Late flowering red clover undersown in winter rye in April and ploughed in at the end of October

1972 Blocks II and IV: Late flowering red clover undersown in winter rye at end of April and ploughed in at the end of November

Basal applications

1964	Lc and Ln	25 kg N	63 kg $P_2 0_5$	63 kg $K_2 0$ in seedbed
	Gm	63 kg N	63 kg $P_2 0_5$	63 kg $K_2 0$ in seedbed
1965	Lc and Ln	63 kg N	63 kg $P_2 0_5$	63 kg $K_2 0$ in seedbed
	Ln	63 kg N after first cut		

N applications to Ln during the season

1966	190 kg N in 3 dressings: in spring and after first two cuts
1967-69	125 kg N in 2 dressings: in spring and after first cut
1970-71	250 kg N in 2 dressings: in spring and after first cut
1972	Blocks II and IV 250 kg N in 2 dressings: in spring and after first cut.

1970	Beans	63 kg $P_2 0_5$ 125 kg $K_2 0$ as (0-14-28)
1971	Rye	31 kg N in spring
1972	Rye (Blocks II and IV)	40 kg N in spring 63 kg $P_2 0_5$ 125 kg $K_2 0$ as (0-14-28) 40 kg MgO as Epsom Salts
	Potatoes (Blocks I and III)	460 kg $P_2 0_5$ and 480 kg $K_2 0$, half in autumn and half in spring. 100 kg MgO as Epsom Salts in spring.
1973	Potatoes as in 1972	

Fertiliser used except where stated:
P: superphosphate, K: muriate of potash

Liming

1969 Ground chalk at 5.0 t/ha to whole area

Weedkillers

Barley:	1966	Paraquat
Winter wheat:	1968 & 1973	Ioxynil and mecoprop
Potatoes:	1973	Linuron with paraquat
Beans:	1970	Simazine

https://doi.org/10.23637/ERADOC-1-193 *pp 26*

Other chemicals applied

Potatoes:	1967, 1972 & 1973	Mancozeb and undiluted B.O.V.
Sugar beet:	1969	Demeton-S-methyl
Beans:	1970	Demeton-S-methyl

Varieties

Winter wheat:	1968 & 1973	Cappelle
Potatoes:	1967	Majestic
	1972 & 1973	Pentland Crown
Barley:	1966	Maris Badger
Sugar beet:	1969	Klein E
Rye:	1971 & 1972	King II
Beans:	1970	Maris Bead

Seeds mixtures	Lc	Ln
S48 Timothy	25%	31%
S215 Meadow Fescue	42%	46%
Smooth stalked meadow grass	17%	23%
Kersey Red Clover	13%	
S184 Wild White Clover	4%	
Total seeding:	27 kg/ha	29 kg/ha

Areas harvested

Potatoes:	0.00087 – 0.00413
Winter wheat:	0.00173 – 0.00421
Rye & barley:	0.00421
Beans:	0.00393
Sugar beet:	0.00138

Soil series. Cottenham

References

1. Mattingly, G.E.G. (1974)
The Woburn Organic Manure Experiment. I, Design, crop yields and nutrient balances 1964-72.
Rothamsted Experimental Station. Report for 1973, Part 2, 98-133.

2. Mattingly, G.E.G., Chater, M and Poulton, D.R. (1974)
The Woburn Organic Manure Experiment. II, Soil analyses 1964-72, with special reference to changes in carbon and nitrogen.
Rothamsted Experimental Station. Report for 1973, Part 2, 134-151.

https://doi.org/10.23637/ERADOC-1-193 *pp 27*

Table 4

Organic Manuring, Woburn Stackyard B

Cropping and Treatments

Treatment	1964 S	1964 A	1965 S	1965 A	1966 S	1966 A	1967 S	1967 A	1968 S	1968 A	1969 S	1969 A	1970 S	1970 A	1971 S	1971 A	1972 S	1972 A	1973 S	1973 A
Lc Ln	Sown	Pl	Resown		Leys left growing up to: 1971 & 1972										I,III	Pl	II,IV	Pl		
St				+		+		+		+		+		+						
Pt				+		+	+	+		+		+		+						
Gm	IR	Pl	IR	Pl	Tref U/S	Pl		–		LFR U/S	Pl		–		–		LFR U/S	Pl	LFR U/S II,IV	Pl		
Fs				+		+		+		+		+		+						
Dg				50t		50t		25t		50t		50t		25t						
Fd				+		+		+		+		+		+						
Crops	Fallow		Fallow		Barley		Potatoes		Wheat		S.Beet		Beans		W.Rye		W.Rye II,IV Potatoes I,III		Potatoes II,IV Wheat I,III	

Symbols: +Treatment applied. Pl: Ploughed up. IR: Italian ryegrass. LFR: Late Flowering Red Clover.
Tref: Trefoil. U/S: Undersown. S: Spring A: Autumn. t: Tonnes. I, II, III, IV, Blocks.

INTENSIVE CEREALS

WOBURN STACKYARD I

(W/RN/13)

This experiment, started in 1966, deals with the effects of intensive cropping with wheat or barley on yield, incidence of soil-borne diseases and organic matter in the soil. The wheat blocks are situated on part of the site of the Classical Wheat experiment and the barley on the Barley experiment (see Continuous Wheat and Barley, 1877 onwards *Details 1967,* pp 49-52). There are small errors in note (4) p. 49 and Table 19 p.50 and a correct statement is contained in papers I and II of the reference.

Design

For each crop: 2 blocks of 6 whole plots each split into 4 sub-plots (8 in certain seasons)

Treatments

Mustard was sown in the bare fallow in June 1965 and ploughed in during October.

Whole plots: Continuous wheat or barley and each phase of a five-course rotation of 1-year ley (1966 spring sown, 1967-70 autumn sown, 1971-73 spring sown), potatoes and three years of either wheat or barley.

Quarter plots: Nitrogen to the cereal:

Wheat	63 v. 126 v. 188 v. 251 kg N
Barley	50 v. 100 v. 150 v. 200 kg N

Eighth plots: 0 v. 182 kg MgO as Epsom salts on wheat blocks only, applied cumulatively 1968 and 1969.
0 v. 182 kg MgO as Epsom salts on barley block 1969.
Residuals compared with equivalent fresh dressings applied to previously untreated eighth plots on both wheat and barley blocks 1970. (Residuals v. 364 kg for wheat and 182 for barley).

NOTE: Eighth plots were not separately harvested after 1970.

Standard manuring

P and K: For all crops including ley:
126 kg P_2O_5 and 251 kg K_2O half ploughed in and half on plough furrow as (0-14-28)

N: For potatoes: 151 kg N applied to seedbed.

For leys:

1966	50 kg N applied to seedbed in spring.
1967-69	50 kg N top dressed in spring.
1970	126 kg N top dressed in spring and 95 kg N after each of first two cuts.
1971-73	63 kg N in seedbed and 63 kg N eight weeks after sowing: with additional 75 kg N in 1971 and 60 kg N in 1973 after the first cut (1972 only 1 cut taken in September).

https://doi.org/10.23637/ERADOC-1-193 *pp 29*

Liming

1971 5 t magnesium limestone, three quarters ploughed in and one quarter on plough furrow in autumn 1970.

Varieties

Wheat:	1966-73	Cappelle
Barley:	1966-69	Maris Badger
	1970-73	Julia (dressed with ethirimol 1972 and 1973)
Potatoes:	1966	Pentland Dell
	1967-73	Majestic
Seeds mixtures:	1966-69	(Parts by weight) English Italian-ryegrass – 20%; Danish Italian-ryegrass – 40%; English Broad Red Clover – 30%; Canadian Alsike – 10%; sown at 32 kg.
	1970-72	S 22 Italian-ryegrass sown at 32 kg
	1973	S 22 Italian-ryegrass sown at 38 kg.

Weedkillers

Potatoes	1969-73	Linuron with paraquat (1971 linuron only)
Wheat and barley	1966-71 & 1973	Ioxynil with mecoprop
	1972	2,4-D with dichlorprop
	1970 and 1972	Paraquat applied previous autumn.

Other chemicals

Potatoes	1966-73	Mancozeb
	1968-73	Demeton-s-methyl
	1967, 1968, 1970 & 1973	B.O.V. (haulm mechanically destroyed other years)

Area harvested

Potatoes:	0.00138 – 0.00343
Wheat & Barley:	0.00134 – 0.00277
Ley:	0.00089 (Yields of leys not taken 1971 and 1972)

Soil series. Stackyard series.

References

1. Johnston, A.E. (1975)
Experiments made on Stackyard Field, Woburn. 1876–1974
I. History of the field, details of the cropping and manuring and the yields in the Continuous Wheat and Barley experiments.

2. Johnston, A.E., Chater, M. (1975)
II. Effects of treatments on soil pH, P and K in the Continuous Wheat and Barley experiments.

3. Mattingly, G.E.G., Chater, M., and Johnston, A.E. (1975)
III. Effects of NPK fertilisers and farmyard manure on soil carbon, nitrogen and organic phosphorous.
Rothamsted Experimental Station. Report for 1974, Part 2, 29-77.

https://doi.org/10.23637/ERADOC-1-193 *pp 30*

ROTATION AND FUMIGATION

WOBURN BUTT CLOSE

(W/RN/15)

This experiment, started in 1969, is designed to study different ways of using nematicides in a three-course rotation and to determine the effects on crop yield and incidence of pathogenic nematodes.

Design

3 series each of 2 blocks of 3 plots split into 7. One phase of a 3-course rotation, potatoes, barley and sugar beet is present in each series.

Treatments

Each crop tests all combinations of:–

Whole plots: N fertiliser (kg N)

Potatoes and Sugar beet	Barley
75	38
150	75
225	113

Sub-plots: Fumigants

(a) None

(b) Dichloropropane/dichloropropene ('D-D' at 448 kg): before potatoes; before sugar beet; before barley; before all crops

Plus 2 reserve sub-plots: one no fumigant: one allocated in 1970 to dazomet at 224 kg before all crops after no treatment in 1969.

NOTE: 'D-D' has been injected into ploughed or cultivated soil in autumn or early winter. Dazomet has been applied and rotary cultivated in before the 'D-D' injection except in December 1971 when it was worked in the following day. In 1971 and 1972 all sub-plots were rotary cultivated, in 1970 and 1973 only dazomet-treated sub-plots were cultivated following application.

Standard manuring

Barley:	310 kg (0-20-20)
Potatoes:	1050 kg (0-14-28)
Sugar beet:	1050 kg (0-14-28)
1971:	13 kg B_2O_3 as 'Solubor'
1972 & '73:	7 kg B_2O_3 as 'Solubor'

Liming

1971-73: 2.5 t magnesian limestone in autumn before sugar beet.

Varieties

Barley:	1969	Zephyr
	1970-73	Julia (dressed with ethirimol 1972 and 73)

https://doi.org/10.23637/ERADOC-1-193 *pp 31*

Potatoes:	1969	King Edward
	1970-73	Pentland Crown
Sugar beet	1969-73	Klein E

Weedkillers

Barley:	1969-72	Ioxynil with mecoprop
Potatoes:	1969-73	Linuron: alone 1971 and 1973 and with paraquat in 1969, 70 and 72.
Sugar beet:	1969-70 and 1972-73	Phenmedipham; and paraquat in 1972

Other chemicals applied

Fungicides	Potatoes	1969-73	Mancozeb
Insecticides	Potatoes and Sugar beet	1969-73	Demeton-s-methyl

Plot area harvested

Barley	0.00052
Potatoes	0.00052 – 0.00104
Sugar beet	0.00057 – 0.00156

Soil series Cottenham series

https://doi.org/10.23637/ERADOC-1-193 *pp 32*

INTENSIVE BARLEY FOLLOWED BY WHEAT AFTER INTENSIVE BARLEY

ROTHAMSTED LITTLE KNOTT I

(R/C5/6)

This experiment, started in 1961, was designed to provide a comparison each year between barley immediately following a two-year break from cereals and barley 2, 3 . . . years after the break. Barley in a four-course rotation (one phase only), continuous barley, continuous winter wheat and continuous spring wheat were also included.

From 1969 winter wheat was the only cereal grown and the experiment was used to study the effects of different sequences of pre-cropping with barley on yields and incidence of take-all *(Gaeumannomyces graminis)* in wheat; break-crops (fallow and beans) were introduced in certain sequences.

Since 1973 only one quarter of the experiment has been continued, primarily for studies on the phenomenon of take-all decline.

Design

Two replicates of 40 treatments in four blocks of 20 (with certain interactions confounded). Later the experiment was analysed as two blocks of 40.

In 1971 each strip of 40 plots was divided across the plots for a test of lime.

In 1973 only two replicates of 10 plots were retained.

Treatments

(1) *Crop sequences*

Treatment	1961	62	63	64	65	66	67	68	69	70	71	72	73
1	0	BE	B	B	B	B	B	B	WW	F	WW	WW	WW
2	WS	0	BE	B	B	B	B	B	WW	WW	WW	F	WW
3	0	WS	0	BE	B	B	B	B	WW	WW	WW	F	BE
4	BE	0	WS	0	BE	B	B	B	WW	WW	WW	WW	F
5	WS	BE	0	WS	0	BE	B	B	WW	WW	WW	WW	WW
6	WS	WS	BE	0	WS	0	BE	B	WW	WW	WW	WW	WW
7	B	B	B	B	B	B	B	B	WW	WW	WW	WW	WW
8	WS	WS	WS	WS	WS	WS	WS	WS	WW	WW	WW	WW	WW
9	WS	WW	WW	WW	WW	WW	WW	F	WW	WW	WW	WW	WW
10	BE	WW	P	B	BE	WW	P	B	F	WW	WW	WW	WW

0 = Oats, BE = Spring beans, B = Barley, WW = Winter wheat, WS = Spring wheat, F = Fallow

(2) *Nitrogen* (kg N as 'Nitro-Chalk')

1961-68	1969 & 70
None (NO)	75 (N3) to former N0 plots
38 (N1)	126 (N5) to former N1 plots
76 (N2)	176 (N7) to former N2 plots
114 (N3)	226 (N9) to former N3 plots

Applied to continuous cereals and to winter wheat and barley in treatment sequence 10.

Nitrogen treatments were discontinued in 1971.

https://doi.org/10.23637/ERADOC-1-193 *pp 33*

(3) *Lime*

1971 Each strip of 40 plots was split across all plots for a test of none (U) v. ground chalk at 12.6 t (L).

Standard applications

Cereals and beans	
1961-68	37.5 kg P_2O_5, 75 kg K_2O as (0-14-28) cereals combine drilled, beans placement drilled. Oats and non-continuous spring wheat: 56 kg N as 'Nitro-Chalk'.
Potatoes	
1963	125 kg N, 125 kg P_2O_5, 225 kg K_2O as (10-10-18).
1967	145 kg N, 145 kg P_2O_5, 225 kg K_2O as (13-13-20).
Winter wheat	
1969	140 kg P_2O_5, 280 kg K_2O as (0-14-28) ploughed in. 40 kg P_2O_5, 40 kg K_2O as (0-20-20) combine drilled.
1970	120 kg P_2O_5, 240 kg K_2O as (0-14-28) ploughed in. 35 kg P_2O_5, 70 kg K_2O as (0-14-28) combine drilled
1971-73	35 kg P_2O_5, 70 kg K_2O as (0-14-28) combine drilled 125 kg N as 'Nitro-Chalk' top dressed.
Spring beans	
1973	55 kg P_2O_5, 110 kg K_2O as (0-14-28)

Liming

1961	3.0 t ground chalk
1966	3.1 t ground chalk
1971	See treatment above
1973	10.0 t on half plots not limed in 1971 and 2.5 t overall.

Weedkillers

Oats, barley, winter and spring wheat:	1961-63	MCPA with TBA
Oats, barley, spring wheat:	1964	MCPA with dichloroprop
Winter wheat:	1964 & 1965	Mecoprop with 2,4-D
Oats:	1965	MCPA with dicamba
Barley:	1965	Mecoprop with 2,4-D
Barley, winter and spring wheat & Oats:	1966-68 1966	Ioxynil with mecoprop
All plots:	1968	Aminotriazole with ammonium thiocyanate in autumn 1967.
Winter wheat:	1969-73	Paraquat in preceding autumn
	1969	Ioxynil, bromoxynil with dichlorprop
	1970-73	Terbutryne and related triazines
	1970	Dichloroprop
	1972 & 1973	Dicamba, / mecoprop with MCPA

https://doi.org/10.23637/ERADOC-1-193 *pp 34*

Other chemicals applied

Beans:	1961, 1963, 1966, 1967	Demeton-S-methyl
	1965	Menazon
	1973	Phorate
Potatoes:	1963	Tops burnt off with B.O.V.
	1967	Mancozeb

Varieties

Barley:	1961-68	Proctor
Winter wheat:	1962-67, 1969, 1973.	Cappelle
	1970-72	Joss Cambier
Spring wheat:	1961-68	Jufy I
Spring beans:	1961-66	Tick
	1967	Tarvin
	1973	Minor
Oats:	1961-66	Condor
Potatoes:	1963 & 1967	Majestic

Areas harvested

Yields were taken for barley, winter and spring wheat only

1961-70 & 1973		0.00563 – 0.005 (1968 S. wheat: 0.00761)
1971 & 1972	Sub-plot area harvested	0.00266 – 0.00269

Soil series Batcombe and Hook series.

https://doi.org/10.23637/ERADOC-1-193 *pp 35*

LONG-TERM LIMING
ROTHAMSTED (R) SAWYERS I
WOBURN (W) STACKYARD SERIES C
(R & W/CS/10)

These experiments have continued on the lines set out in *Details 1967*, pp. 95-96.

The cropping has been:

1968	Potatoes	Majestic
1969	Fallow	
1970-73	Barley	Julia (dressed with ethirimol 1972 & 1973)

Treatments

(a) No lime was applied 1968-73.

Ground chalk: total applied 1962 and 1963 (tonnes $CaCO_3$)

Rothamsted	Woburn
None	None
5	5
10	12
20	19

(b) Phosphate: 1968 0 v. 126 kg P_2O_5 as superphosphate
1970-73 0 v. 63 kg P_2O_5 as superphosphate

(c) Potash: 1968 0 v. 188 kg K_2O as muriate of potash
1970-73 0 v. 126 kg K_2O as muriate of potash

P and K were applied cumulatively from 1962
No treatments were applied to the fallow in 1969

Basal applications

Nitrogen

1968	Rothamsted	188 kg N	broadcast before planting
	Woburn	251 kg N	
1970-73	Rothamsted	95 kg N	combine drilled
	Woburn	126 kg N	broadcast before planting

Weedkillers

Potatoes:	1968 (R) & (W)	Paraquat with linuron
Barley:	1970 (R)	2,4-D with dichlorprop
	(W)	Ioxynil with mecoprop
	1971 (R)	Ioxynil, bromoxynil with dichlorprop
	(W)	Paraquat. Ioxynil with mecoprop
	1972 (R)	Paraquat. Ioxynil, bromoxynil, dichlorprop and MCPA
	(W)	Paraquat
	1973 (R)	Dicamba with mecoprop and MCPA
	(W)	Ioxynil with mecoprop

Other chemicals applied

Potatoes:	1968 (R) & (W)	Mancozeb and demeton-S-methyl. Haulm burnt off with sulphuric acid.

https://doi.org/10.23637/ERADOC-1-193 *pp 36*

Areas harvested

1968	(R)	0.00384
	(W)	0.00510
1970-73	(R)	0.00512 – 0.00518
	(W)	0.00516 – 0.00520

Soil series. (R) Batcombe series with sandier variants.
(W) Cottenham series.

References

1. Bolton, J. (1971)
Long term liming experiments at Rothamsted and Woburn.
Rothamsted Experimental Station. Report for 1970, Part 2, 98-112.

https://doi.org/10.23637/ERADOC-1-193 *pp 37*

NITROGEN LEVELS TO OLD GRASS

ROTHAMSTED PARK GRASS

(R/CS/13)

This experiment, started in 1965, studies the effects of a range of nitrogen rates on yield and botanical composition of very old permanent pasture given a single dressing of P and K annually. The contribution of legumes to the productivity of the sward is studied by spraying half of the N0 plots with weedkillers. The effects of treatments on nutrients available in the soil are also studied. From 1965-69 the effects of 3 and 6 applications of N and grass cuts were measured. From 1970 the N was applied in four equal dressings, one for each cut. The effect of Mg on Mg content of the herbage was also studied for 1970 and 1971. The experiment is located on plot 6/1 of the Park Grass Experiment which received P, K, Na, Mg annually 1869-1964 after N only (96 kg N) 1856-68.

Design

4 randomised blocks of 10 plots. The magnesium treatments 1970 and 1971 and the extra N treatments from 1972 were arranged on the original treatments:–

Treatments 1965-69

Cuts			3					6		
Total N	0	0[x]	1	2	3	0	0[x]	1	2	3

Treatments 1970-71

Cuts			4					4		
Total N	0	0[x]	1	2	3	0	0[x]	1	2	3
Mg level										
Blocks I & II	1	1	2	1	2	2	2	1	2	1
Blocks III & IV	2	2	1	2	1	1	1	2	1	2

Treatments 1972–

Cuts			4					4		
Total N	0	0[x]	1	3	5	0	0[x]	2	4	6

[x] Plots treated with mecoprop to eliminate clovers.

Treatments

(1) *Nitrogen* (kg N per annum as 'Nitro-Chalk')

		1965-71		1972–	
No. of cuts		None	(N0)	None	(N0)
(A)		145	(N1)	75	(N1)
(A)		290	(N2)	225	(N3)
(A)		435	(N3)	375	(N5)
(B)		145	(N1)	150	(N2)
(B)		290	(N2)	300	(N4)
(B)		435	(N3)	450	(N6)
(A)	1965 & 1966	3 cuts/annum, N applied equally for each.			
	1967	3 cuts/annum, N applied in 6 equal dressings.			

https://doi.org/10.23637/ERADOC-1-193 *pp 38*

	1968 & 1969	6 cuts/annum, N applied in 3 equal dressings for first, third and fifth cuts.
(B)	1965-69	6 cuts/annum, N applied equally for each.
(A) and (B)		
	From 1970	4 cuts/annum, N applied equally for each.

(2) *Control of legumes*
Two plots per block receiving no N are sprayed with mecoprop, once annually 1965, 1967 and 1969 and twice 1966, 1968 and 1970-73.

(3) *Magnesium*

1970 and 1971	28 kg Mg v. 56 kg Mg each year as magnesium sulphate.

Basal applications

1965–	34 kp P as superphosphate, 224 kg K as potassium sulphate.
1965-69	16 kg Na as sodium sulphate.
1965-69, 1972 & 1973	11 kg Mg as magnesium sulphate.

Liming (as ground chalk)

1965	8.7 t
1968	7.5 t
1970	2.9 t

Plot areas harvested 0.00086 – 0.00090

Soil series Batcombe series.

https://doi.org/10.23637/ERADOC-1-193 *pp 39*

NPK TO OLD GRASS

ROTHAMSTED PARK GRASS

(R/CS/14)

This experiment, started in 1965, studies the effects of a range of P and K levels on yields of permanent pasture and is located on Park Grass plots 5/1 and 5/2 which provide sites with little and much P and K respectively.

Design

On each site a single replicate of 2 x 4 x 4 in 2 blocks of 16 plots each, with 2 x 2 additional plots in each block.

Treatments

(1) The sites differ in previous history:

Plot 5/1:	1856-97	96 kg N annually
	1898-1964	Unmanured
Plots 5/2:	1856-97	96 kg N annually
	1898-1964	Superphosphate and sulphate of potash to supply 34 kg P and 224 kg K annually.

(2) On each site all combinations of:

(a) Nitrogen fertiliser (kg N for each cut)

	N1	N2
1965	37.5	75
1966	56.0	112
1967-73	33.6	67.2

(b) Phosphate (Kg P) annually as superphosphate

P0	None
P1	16.8
P2	33.6
P4	67.2

(c) Potassium (kg K) annually as potassium chloride

K0	None
K2	112
K4	224
K8	448

(3) Together with extra treatments on each site:
all combinations of:

(a) nitrogen fertiliser as 2(a)

(b) residues of PK fertiliser applied 1965 only

33.6 kg P + 56.1 kg K
33.6 kg P + 336 kg K

Number of nitrogen applications have been:

1965	4
1966	3
1967	5/1 – 3; 5/2 – 4
1968 & 1969	3

https://doi.org/10.23637/ERADOC-1-193 *pp 40*

1970 & 1971	2
1972	3
1973	3

Liming

Ground chalk applied (t/ha)

1965:	Plot 5/1 – 12.8	plot 5/2 – 11.5
1968:	Plot 5/1 – 6.2	plot 5/2 – 5.5
1970:	Both plots – 8.8	

Area harvested 0.00085 – 0.00090

Soil series Batcombe series

https://doi.org/10.23637/ERADOC-1-193 *pp 41*

PK AND TAKE-ALL

ROTHAMSTED WEST BARNFIELD II

(R/CS/24)

This experiment, started in 1968, is designed to study the effects of different amounts of phosphate and potash on the yield and incidence of soil-borne diseases, particulary take-all (*Gaeumannomyces graminis)* in continuous cereals (barley until 1973).

Design

1968-69:	5 x 2, in 4 randomised blocks of 10 plots
1970–	5 x 2 x 4 in 4 blocks of 10 plots split into two for N.

Treatments

All combinations of:

Whole plots	(a)	Phosphate (kg $P_2 0_5$) as superphosphate
None		
38		annually to seedbed
150		
226		Six-yearly, last applied autumn 1967, half
904		before ploughing, half after
	(b)	Potash (kg $K_2 0$) as muriate of potash
37.5		annually to seedbed
150		

NOTE: Rates of P and K have been slightly changed from 1974 From 1970.

Sub-plots	(c)	Nitrogen (kg N) applied cumulatively in successive years
38		
75		
113		
150		

Basal applications

Nitrogen:	1968 & 1969	100 kg N

Liming

1969	2.9 t ground chalk
1972	5.0 t ground chalk

Weedkillers

1968 & 1969, 1971-73	Paraquat applied to stubble in previous autumn
1968	Aminotriazole with ammonium thiocyanate in previous autumn
1969 & 1970	2,4-D with dichlorprop
1971	Ioxynil, bromoxynil with dichlorprop
1972	Ioxynil, bromoxynil, dichlorprop with MCPA
1973	Dicamba, mecoprop with MCPA

https://doi.org/10.23637/ERADOC-1-193 *pp 42*

Varieties	
1968 & 1969	Maris Badger
1970-73	Julia
Areas harvested	
1968 & 1969	0.00567
1970	0.00264 – 0.00273
Soil series	Hook series

https://doi.org/10.23637/ERADOC-1-193