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Yields of the Field Experiments 2011

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Results of the
Classical and other
Long-term Experiments
2011

W/RN/3 Ley Arable

Rothamsted Research

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11/W/RN/3

LEY/ARABLE

Object: To compare the effects on soil fertility of rotations with or without leys – Woburn, Stackyard D.

Sponsors: A. J. Macdonald

The 74th year, leys, w. beans, w. wheat, w. rye

For previous years see 'Details' 1967 & 1973 and Yield Books for 74-10/W/RN/3.

Design: 5 series of 8 plots, split for treatments other than rotations.

Whole plot dimensions: 8.53 x 40.7

Treatments: All phases of four five-course rotations were originally present:

ROTATION

LEY	Clover/grass ley:	L, L, L, P, W
CLO	All legume ley:	SA, SA, SA, P, W until 1971 then CL, CL, CL, P, W.
A	Arable with roots:	P, R, C, P, W until 1971 then P, B, B, P, W.
A H	Arable with hay:	P, R, H, P, W until 1971 then P, B, H, P, W.

P = potatoes, R = w. rye, C = carrots, W = w. wheat, B = s. barley, H = hay, L = clover/grass ley, SA = sainfoin ley, CL = red clover ley.

Rotations themselves followed different cycles:

On four plots in each block the rotations were repeated.

On four plots in each block arable rotations alternated each five years with ley rotations.

From 1976 all the rotations were changed on all phases except for the first and second test crops in 1976:

LN 3	(Previous LEY) LN1, LN2, LN3, W, R
LC 3	(Previous CLO) LC1, LC2, LC3, W, R
AF	(Previous A) F, F, BE, W, R
AB	(Previous A H) B, B, BE, W, R

From 1988 rotations AF and AB are replaced by AM and ABe respectively. Phased in at the beginning of each treatment crop sequence.

AM	R, BE, M, W, R
ABe	R, M, BE, W, R

LN1 to LN3 = three year grass ley with N, 1st year to 3rd year,
LC = clover/grass ley, no N, BE = beans (s. oats until 1980), F = fallow,
M = forage maize

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Plots hitherto in alternating rotations were changed to test eight-year leys and two test crops:
 LLN LLN1, LLN2, LLN3, LLN4, LLN5, LLN6, LLN7, LLN8, W, R
 LLC LLC1, LLC2, LLC3, LLC4, LLC5, LLC6, LLC7, LLC8, W, R
 LLN1 to LLN8 = eight year grass ley with nitrogen, first year to eighth year, similarly for
 LLC – clover/grass ley, no nitrogen

The new scheme started by sowing these new leys in spring 1976 on four phases and in spring 1977 on the fifth phase (2nd test crop in 1976).

In 1992 w. rye (R) replaced s. barley (B) as the second test crop. Yields are taken from the leys, arable treatment crops and the test crops.

From 2007 plots previously in the 1st cycle of testing eight-year leys followed by two arable test crops (i.e. those plots which were changed to eight-year ley treatments in 1976 or 1977) changed to a three-year arable rotation followed by two arable test crops. Plots were “phased in” but joined the relevant point in the rotation. From 2008 the second cycle 8-yr grass and grass/clover leys changed to 3-yr grass or grass/clover leys respectively. They will be phased in between 2008 and 2012.

LLN/AO (Previously 1st cycle, 8-yr grass ley) R, BE, O, W, R
 LLC/ABe (Previously 1st cycle, 8-yr grass/clover ley) R, O, BE, W, R
 LLC/LC3 (Previously 2nd cycle, 8-yr grass ley) Lc 1, Lc 2, Lc 3, W, R
 LLN/LN3 (Previously 2nd cycle, 8-yr grass/clover ley) Ln 1, Ln 2, Ln 3, W, R

From 2009 W oats (O) replaced forage maize (M) in the AM and ABe rotations on block III and were phased in on blocks V, IV, II and I in subsequent years. The AM treatment was re-named AM/AO.

Treatments to first test crop w. wheat, all combinations of:

Whole plots:

1. ROTATION Rotations before wheat:

LLN 8
 LN 3
 LLC 8
 LC 3
 LLC/LC3 not yet in phase
 LLN/LN3 not yet in phase
 LLN/AO not yet in phase
 LLC/ABe not yet in phase
 AM/AO
 ABe

1/ 2 plots:

2. NSPLIT(FYM res) Farmyard manure residues, last applied 1960s: Split N v single N dressing to wheat, tested 2001-5

Nsplit (noFYM)
 Nsingle(FYM)

1/8 plots:

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3. **N** Nitrogen fertilizer as split dressings in spring 2011
(kg N) as 34.5% N:
- | | | |
|-----|----------|-----------------------------|
| 0 | 0 | |
| 80 | 40 + 40 |) to be applied |
| 160 | 40 + 120 |) late-February/early-March |
| 240 | 40+ 200 |) and mid-April |

Treatments to second test crop w.rye, all combinations of:

Whole plots:

1. **ROTATION** Rotations before first test crop:
- LLN8
 - LN 3
 - LLC 8
 - LC 3
 - LLC/LC3 not yet in phase
 - LLN/LN3 not yet in phase
 - LLN/AO not yet in phase
 - LLC/ABe not yet in phase
 - AM/AO
 - ABe

1/ 2 plots:

2. **NSPLIT(FYM res)** Farmyard manure residues, last applied 1960s:
- Nsplit to wheat (no FYM)
 - Nsingle to wheat (FYM)
- 1/8 plots:

3. **N** Nitrogen fertilizer in spring 2009 (kg N) as 34.5%:
- 0
 - 50
 - 100
 - 150

Treatments to leys:

- FYM RES** Farmyard manure residues:
- NONE
 - FYM 38 t on each occasion, last applied 1960s.

NOTE: Corrective K dressings (kg K₂O ha⁻¹) as muriate of potash, applied where necessary to first test crop w. wheat and long-term leys in the wheat block, applied about September 2010 (actual date not recorded).

Continuous rotations	No FYM	FYM Res
Before wheat	Half plots	Half plots
Abe/Be	250	270
AO/O	300	350
LLn/AO	30	120
None to other plots.		

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Experimental Diary

Grass ley and clover/grass ley (ROTATION LN1, LLN/LN1, LC1, LLC/LC1)

			Rate	Unit
30-Sep-10	p	Sprayed Gallup 360 in 200 l/ha. To all stubbles and grass to be ploughed out.	4	l/ha
24-Oct-10	f	Broadcast Potassium Sulphate and TSP.	140 213	kg/ha kg/ha
25-Oct-10	a	Ploughed, ransomes 3 furrow at 14". Plots for Wheat, Rye, Oats and Leys only.		
29-Oct-10	a	Rotary Harrowed, plots for Wheat, Oats, Rye and Leys only.		
29-Oct-10	s	Drilled Ley mixture. Grass only ley, Laura Fescue and Promesse Timothy, 50/50 split. Grass/Clover ley, Laura, Promesse and Avota white Clover, 44/44/12 split.	40	kg/ha
29-Oct-10	a	Cambridge Rolled.		
01-Nov-10	f	Broadcast Nitrochalk, 27%N: Clover/Grass ley.	93	kg/ha
		Grass ley.	185	kg/ha
25-Mar-11	f	Broadcast Nitram, to grass only ley plots.	217	kg/ha
25-Mar-11	f	Broadcast Muriate of Potash, to all ley plots.	167	kg/ha
21-Jun-11	a	Yield strip mown, sampled and weighed (Cut 1).		
22-Jun-11	a	Mown with Kuhn.		
25-Jun-11	a	Leys tedded.		
26-Jun-11	a	Windrowed.		
27-Jun-11	a	Round baled.		
31-Oct-11	a	Yield strip mown, sampled and weighed (Cut 2).		

Grass ley and clover/grass ley (ROTATION, LN2-3, LLN/LN2-3, LC2-3, LLC/LC2-3)

			Rate	Unit
25-Mar-11	f	Broadcast Nitram, to grass only ley plots.	217	kg/ha
25-Mar-11	f	Broadcast Muriate of Potash, to ley plots.	167	kg/ha
25-Mar-11		Broadcast Potassium Sulphate and TSP.	140 213	kg/ha kg/ha
21-Jun-11	a	Yield strip mown, sampled and weighed (Cut 1).		
22-Jun-11	a	Mown with Kuhn.		
25-Jun-11	a	Leys tedded.		
26-Jun-11	a	Windrowed.		
27-Jun-11	a	Round baled.		
27-Jun-11	f	Broadcast 34.5 % N Nitram. Grass only ley plots on blocks 2 and 4.	217	kg/ha
27-Jun-11	f	Broadcast Muriate of Potash. Ley plots only on blocks 2 and 4.	83	kg/ha

15-Aug-11	p	Sprayed Hoedown in 200l/ha. To all crops except leys to be kept.	4	l/ha
31-Oct-11	a	Yield strip mown, sampled and weighed (Cut 2).		

W Beans

			Rate	Unit
30-Sep-10	p	Sprayed Gallup 360 in 200 l/ha to all stubbles and grass to be ploughed out.	4	l/ha
24-Oct-10	f	Broadcast TSP, pre arable crops only.	127	kg/ha
14-Dec-10	s	Broadcast Wizard @ 33 seeds/m ² . Ploughed in with Ransomes 3 furrow at 14".		
25-Mar-11	f	Broadcast Potassium Sulphate to arable crops.	150	kg/ha
15-Aug-11	p	Sprayed Hoedown in 200 l/ha.	4	l/ha
31-Aug-11	a	Combined plots for yields with Sampo and swathed straw		
02-Sep-11	a	Combined O+Es		
07-Sep-11	a	Baled and removed straw		

W Wheat (1st Test Crop)

			Rate	Unit
30-Sep-10	p	Sprayed Gallup 360 in 200 l/ha.	4	l/ha
24-Oct-10	f	Broadcast TSP.	127	kg/ha
25-Oct-10	a	Ploughed with Ransomes 3 furrow at 14".		
29-Oct-10	a	Rotary Harrowed.		
29-Oct-10	s	Drilled Glasgow, dressed Redigo Deter, 350 seeds/m ² .		
29-Oct-10	a	Cambridge Rolled.		
22-Mar-11	f	Broadcast Nitrochalk, 27%N; 1 st Split N application, as scheduled.	145	kg/ha
25-Mar-11	f	Broadcast Potassium Sulphate, to arable crops.	150	kg/ha
28-Mar-11	p	Sprayed Cherokee and Manganese in 200l/ha.	1.25 1.50	l/ha l/ha
12-Apr-11	f	Broadcast Nitrochalk, 27%N; 2 nd Split N application: Nitrochalk – N1 plots Nitrochalk – N2 plots Nitrochalk – N3 plots	145 436 727	kg/ha kg/ha kg/ha
11-May-11	p	Sprayed Tracker with Bravo 500 Justice and CCC; all in 200l/ha.	1.0 1.0 0.25 2.25	l/ha l/ha l/ha l/ha
20-May-11	p	Sprayed Thor in 200l/ha.	20	g/ha
15-Aug-11	p	Sprayed Hoedown in 200l/ha.	4	l/ha
31-Aug-11	a	Combined for yields with Sampo and swathed straw		
02-Sep-11	a	Combined O+Es		
07-Sep-11	a	Baled and removed straw		

W Rye (2nd Test Crop)

			Rate	Unit
30-Sep-10	p	Sprayed Gallup 360 in 200 l/ha.	4	l/ha
21-Oct-10	a	Broadcast Limestone, block 1 only.	5	t/ha
24-Oct-10	f	Broadcast TSP.	127	kg/ha
25-Oct-10	a	Ploughed, Ransomes 3 furrow at 14".		
29-Oct-10	a	Rotary Harrowed plots.		
29-Oct-10	s	Drilled Agronom, dressed Tripod, 350 seeds/m ² .		
29-Oct-10	a	Cambridge Rolled.		
25-Mar-11	f	Broadcast Potassium Sulphate.	150	kg/ha
12-Apr-11	f	Broadcast Nitrochalk, 27%N, as scheduled.		
		Nitrochalk – rye, N1 plots	180	kg/ha
		Nitrochalk – rye, N2 plots	364	kg/ha
		Nitrochalk – rye, N3 plots	545	kg/ha
18-Apr-11	f	Broadcast Nitram, 34.5 %N; treatment crops only.	290	kg/ha
31-Aug-11	a	Combined all plots for yields with Sampo and swathed straw		
02-Sep-11	a	Combined O+Es		
07-Sep-11	a	Baled and removed straw		

W Oats (Rotation)

			Rate	Unit
30-Sep-10	p	Sprayed Gallup 360 in 200 l/ha.	4	l/ha
24-Oct-10	f	Broadcast TSP, pre arable crops only.	127	kg/ha
25-Oct-10	a	Ploughed, Ransomes 3 furrow at 14".		
29-Oct-10	a	Rotary Harrowed plots.		
29-Oct-10	s	Drilled Gerald, 350 seeds/m ² .		
29-Oct-10	a	Cambridge Rolled.		
25-Mar-11	f	Broadcast Potassium Sulphate.	150	kg/ha
18-Apr-11	f	Broadcast Nitram N, 34.5 %N.	290	kg/ha
20-May-11	p	Sprayed Thor in 200l/ha	20	g/ha
31-Aug-11	a	Combined all plots for yields with Sampo and swathed straw		
02-Sep-11	a	Combined O+Es		
07-Sep-11	a	Baled and removed straw		

11/W/RN/3

LEYS

1st CUT (21/06/11) DRY MATTER TONNES/HECTARE

***** Tables of means *****

FYM_RES	NONE	FYM	Mean
LEY			
LC1	1.93	2.31	2.12
LC2	4.09	3.39	3.74

LC3	4.29	2.88	3.59
LN1	4.30	3.82	4.06
LN2	4.78	5.18	4.98
LN3	5.26	5.52	5.39
(LLC/LC) LC1	3.76	2.87	3.31
(LLC/LC) LC2	4.21	3.55	3.88
(LLC/LC) LC3	4.29	4.49	4.39
(LLC/LC) LN1	4.01	4.69	4.35
(LLC/LC) LN2	4.72	4.59	4.66
(LLC/LC) LN3	5.32	6.01	5.67
MEAN	4.25	4.11	4.18

1ST CUT MEAN DM% 28.3

1ST CUT Units AREA HARVESTED 0.00200

2nd CUT (24-30/11/11) DRY MATTER TONNES/HECTARE

***** Tables of means *****

FYM_RES	NONE	FYM	Mean
LEY			
LC1	0.25	0.35	0.30
LC2	1.20	0.84	1.02
LC3	0.00	0.00	0.00
LN1	0.40	0.40	0.40
LN2	2.00	1.67	1.84
LN3	0.00	0.00	0.00
(LLC/LC) LC1	0.40	0.34	0.37
(LLC/LC) LC2	1.31	1.05	1.18
(LLC/LC) LC3	0.00	0.00	0.00
(LLC/LC) LN1	0.47	0.66	0.56
(LLC/LC) LN2	0.90	1.18	1.04
(LLC/LC) LN3	0.00	0.00	0.00
MEAN	0.58	0.54	0.56

2nd CUT MEAN DM% 27.2

2nd CUT Units AREA HARVESTED 0.00200

TOTAL OF 2 CUTS DRY MATTER TONNES/HECTARE

***** Tables of means *****

FYM_RES	NONE	FYM	Mean
LEY			
LC1	2.18	2.66	2.42
LC2	5.29	4.24	4.76
LC3	4.29	2.88	3.59
LN1	4.70	4.22	4.46

LN2	6.78	6.85	6.82
LN3	5.26	5.52	5.39
(LLC/LC) LC1	4.17	3.20	3.69
(LLC/LC) LC2	5.53	4.60	5.06
(LLC/LC) LC3	4.29	4.49	4.39
(LLC/LC) LN1	4.48	5.34	4.91
(LLC/LC) LN2	5.62	5.77	5.69
(LLC/LC) LN3	5.32	6.01	5.67
MEAN	4.83	4.65	4.74

TOTAL OF 2 CUTS MEAN DM% 28.3

AREA HARVESTED 0.00200

ARABLE TREATMENT CROPS 11/WRN/3

BEANS

GRAIN TONNES/HECTARE

*****Tables of means *****

FYMRES ROTATION	NONE	FYM	Mean
(AO) Be	1.68	1.60	1.64
(LLn/AO) Be	1.27	1.29	1.28
(LLc/ABe) Be	3.49	4.37	3.93
(ABe) Be	1.68	1.71	1.70
MEAN	2.03	2.25	

Grain mean DM% 83.6
Plot area harvested 0.00413

OATS

GRAIN TONNES/HECTARE

***** Tables of means *****

FYMRES ROTATION	NONE	FYM	Mean
(Abe) O	5.16	5.12	5.14
(AO) O	5.95	6.28	6.12
(LLc/ABe) O	3.55	3.16	3.35
(LLn/AO) O	6.73	6.35	6.54
Mean	5.35	5.23	

Grain mean DM% 86.7
Plot area harvested 0.00413

RYE

GRAIN TONNES/HECTARE

*****Tables of means *****

	FYMRES	NONE	FYM	Mean
ROTATION				
(ABe) R		3.83	3.39	3.61
(AO) R		3.22	3.49	3.36
(LLn/AO) R		5.49	5.56	5.53
(LLc/ABe) R		4.34	4.20	4.27
MEAN		4.22	4.16	4.19

Grain mean DM%	84.6
Plot area harvested	0.00413

W.WHEAT (1st TEST CROP)

GRAIN TONNES/HECTARE

***** Tables of means *****

ROTATION	FYMRES	none	FYM	Mean
LLn/Ln		4.52	5.32	4.92
Ln		4.94	4.54	4.74
LLc/ABe		4.79	4.67	4.73
Lc		4.73	4.38	4.55
AO		3.39	3.55	3.47
ABe		2.49	3.88	3.19
LLn/AO		4.64	5.39	5.02
LLc/Lc		5.48	5.93	5.71
MEAN		4.37	4.71	4.54

ROTATION	N	0	80	160	240
LLn/Ln		3.37	4.22	6.22	5.89
Ln		2.92	4.99	5.70	5.34
LLc/ABe		2.77	4.27	5.92	5.95
Lc		2.62	4.88	5.64	5.07
AO		1.25	2.92	4.59	5.11
ABe		0.87	2.75	4.88	4.25
LLn/AO		2.28	4.61	6.30	6.87
LLc/Lc		3.25	5.75	6.68	7.13
MEAN		2.42	4.30	5.74	5.70

FYMRES	N	0	80	160	240
None		2.18	4.09	5.63	5.59
FYM		2.65	4.51	5.85	5.82

FYMRES					
ROTATION	N	0	80	160	240
LLn/Ln	none	3.23	3.85	5.57	5.45
	FYM	3.50	4.59	6.87	6.33
Ln	none	3.02	5.37	5.94	5.41
	FYM	2.82	4.61	5.45	5.28
LLc/ABe	none	2.49	3.56	6.78	6.35
	FYM	3.06	4.99	5.06	5.55
Lc	none	2.15	4.87	6.11	5.77
	FYM	3.09	4.90	5.18	4.36
AO	none	1.29	2.85	4.64	4.79
	FYM	1.21	2.99	4.55	5.44
ABe	none	0.44	2.35	4.05	3.14
	FYM	1.29	3.15	5.72	5.37
LLn/AO	none	1.87	4.29	5.63	6.77
	FYM	2.70	4.93	6.96	6.97
LLc/Lc	none	2.96	5.62	6.35	7.00
	FYM	3.54	5.89	7.02	7.27
Plot area harvested		0.00192			
Grain mean		DM%	84.3		

RYE (2nd TEST CROP)

GRAIN TONNES/HECTARE

*****Tables of means *****

FYMRES	none	FYM	MEAN	
ROTATION				
LLn/Ln	4.23	4.91	4.57	
Ln	4.93	5.01	4.97	
LLc/Lc	5.02	4.17	4.60	
Lc	4.26	4.95	4.60	
AO	3.59	3.61	3.60	
ABe	3.60	3.86	3.73	
LLn/AO	3.74	3.95	3.84	
LLc/ABe	4.19	3.77	3.97	
N	0	50	100	150
ROTATION				
LLn/Ln	2.72	5.17	5.32	5.07
Ln	3.47	4.82	5.44	6.15
LLc/Lc	3.40	4.38	5.43	5.17
Lc	3.57	4.48	5.34	5.01
AO	1.25	3.46	4.66	5.02
ABe	1.76	3.61	4.55	4.99
LLn/AO	2.42	3.47	4.48	4.99
LLc/ABe	2.34	3.28	4.96	5.32
MEAN	2.62	4.09	5.02	5.22

	N	0	50	100	150	Mean
FYMRES						
None		2.77	3.97	4.88	5.16	4.19
FYM		2.47	4.20	5.17	5.27	4.28

	N		0	50	100	150
ROTATION						
FYMRES						
LLn/Ln	none	2.82	4.23	4.71	5.14	
	FYM	2.62	6.10	5.93	4.99	
Ln	none	3.71	4.87	5.12	6.04	
	FYM	3.23	4.78	5.77	6.26	
LLc/Lc	none	3.96	4.79	5.72	5.63	
	FYM	2.84	3.98	5.14	4.71	
Lc	none	3.47	4.03	4.88	4.64	
	FYM	3.68	4.94	5.79	5.38	
AO	none	1.35	3.29	4.64	5.09	
	FYM	1.15	3.64	4.68	4.95	
ABe	none	1.93	3.60	4.42	4.45	
	FYM	1.59	3.63	4.69	5.54	
LLn/AO	none	2.36	3.24	4.62	4.74	
	FYM	2.48	3.71	4.35	5.24	
LLc/ABe	none	2.55	3.70	4.91	5.55	
	FYM	2.13	2.86	5.01	5.09	

Plot area harvested 0.00192
Grain mean DM% 84.5