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Yields of the Field Experiments 2013

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W/RN/3 Ley Arable

Rothamsted Research

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13/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 76th year, leys, w. beans, w. wheat, w. rye

For previous years see 'Details' 1967 & 1973 and Yield Books for 74-12/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 were 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 2013 (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:
   N split to wheat (no FYM)
   N single to wheat (FYM)

   1/8 plots:

3. **N** Nitrogen fertilizer in spring 2013 (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 K_2O ha^{-1}) as muriate of potash, applied where necessary to first test crop w. wheat and long-term leys in the wheat block, applied 2013 (see date below).

Continuous rotations	No FYM	FYM Res
Before wheat	Half plots	Half plots
Abe/Be	270	340
AO/O	200	270
LLn/AO	0	30
Ln/Ln	90	70
None to other plots.		

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Experimental Diary

Date		Application	Rate	Units
All				
20-Oct-12	p	Sprayed glyphosate - grass plots not sprayed.	4	l/ha
15-Nov-12	f	Applied TSP to blocks 4 and 5 and plots: 1,2,5,6,9,10,15,16,17,18,19,20,21,22,27,28,35,36,39, 40,45,46,47,48.	127	kg/ha
19-Nov-12	a	Ploughed	—	—
21-Feb-13	a	Spring tined	—	—
20-Apr-13	f	Applied Sulphate of Potash - applied to all arable plots only.	150	kg/ha
02-May-13	a	Rolled wheat, rye, oats and leys to control wireworms	—	—
12-Sep-13	p	Sprayed Gallup 360 to whole trial except 1st and 2nd year leys.	4	l/ha
Grass ley and clover/grass leys (first year leys)				
14-Nov-12	f	Applied Potassium Sulphate to plots 33,34,37,38,41,42,43,44 also.	140	kg/ha
14-Nov-12	f	Applied TSP to plots 3,4,7,8,11,12,13,14,23,24,25,26,29,30,31,32.	213	kg/ha
15-Nov-12	f	Applied TSP to plots 33,34,37,38,41,42,43,44.	213	kg/ha
15-Nov-12	f	Applied Nitram to plots 33,34,41,42.	25	kg/ha
15-Nov-12	f	Applied Nitram to plots 37,38,43,44.	50	kg/ha
14-Mar-13	s	Drilled Grass plots 37, 38, 43 and 44	30	kg/ha
14-Mar-13	s	Drilled Grass and Clover plots 33, 34, 41 and 42	30	kg/ha
03-Jul-13	a	Mowed the rest of the grass plots	—	—
Grass ley and clover/grass leys (second and third year leys)				
06-Nov-12	a	Topped grass plots - unable to bale and remove, too little grass.	—	—
14-Nov-12	f	Applied Potassium Sulphate to plots 3,4,7,8,11,12,13,14,23,24,25,26,29,30,31 and 32	140	kg/ha
22-Apr-13	f	Applied Nitram to plots 11,12,13,14,25,26,31,32,37,38,43,44.	217	kg/ha
22-Apr-13	f	Applied MOP to plots 3,4,7,8,11,12,13,14,23,24,25,26,29,30,31,32,33,34,37 ,38,41,42,43,44.	167	kg/ha
01-Jul-13	a	Cut grass plots cut for yield	—	—
08-Jul-13	a	Rowed up grass Ley plots	—	—
08-Jul-13	a	Baled and removed ley plots	—	—
15-Jul-13	f	Applied Nitram to plots 11,12,13,14,25,26,31,32,37,38,43 and 44	217	kg/ha
15-Jul-13	f	Applied MOP to ley plots	83	kg/ha
13-Nov-13	a	Cut and weighed grass plots for yield - plots 3,4,7,8,11,12,13,14,33,34,37,38,41,42,43,44.	—	—

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13-Nov-13	a	Topped grass plots - grass too short to bale and remove.	—	—
S Beans				
14-Mar-13	s	Drilled Fuego Spring beans - no dressing, plots 22,21,18 and 17.	45	seeds/m^2
15-Mar-13	s	Drilled Fuego plots 5,6,9 and 10. Finished	45	seeds/m^2
02-Jun-13	p	Sprayed Troy 480 SL - sprayed on beans only.	3	l/ha
19-Jun-13	p	Sprayed San 703 and Hallmark with Zeon Technology -spring beans only	1.0 75	l/ha l/ha
05-Jul-13	p	Sprayed San 703 and Hallmark with Zeon Technology -spring beans only	1.5 75	l/ha l/ha
14-Aug-13	p	Sprayed Roundup Max	2	kg/ha
01-Sep-13	a	Cut plots for yield	—	—
04-Sep-13	a	Combined	—	—
06-Sep-13	a	Baled	—	—
S Wheat				
15-Nov-12	f	Applied corrective K to plots 53,54,63,64 as MOP		
13-Mar-13	s	Drilled Zircon tr Kinto spring wheat plots. (Block 4)	4.2 5.4 6.0 4.8	kg/ha kg/ha kg/ha kg/ha
26-Apr-13	f	Applied Nitro-chalk to Block 4 treatment plots only.	350	seeds/m^2
31-May-13	f	Applied main N dressing to wheat (Block 4) by hand as Nitro-chalk.	148	kg/ha
03-Jun-13	p	Sprayed Ally Max, Kindom, Bravo 500 and Hatchet Xtra to wheat only.	148 444 741	kg/ha kg/ha kg/ha
05-Jul-13	p	Sprayed Topik, Ignite, Comet and Zarado to wheat only plots.	Al 42 Ki 1.25 Br 1.00 Ha 0.75 To 0.15 Ig 1.1 Co 0.25 Za 1.0	g/ha l/ha l/ha l/ha l/ha l/ha l/ha l/ha
01-Sep-13	a	Cut plots for yield	—	—
04-Sep-13	a	Combined	—	—
06-Sep-13	a	Baled	—	—

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S Rye

16-Nov-12	a	Applied Chalk, Block 5.		
13-Mar-13	s	Drilled Ovid, Spring Rye. No dressing. Block 5 and plots 35,36,39,40,45,46,47 and 48	5	t/ha
03-May-13	f	Applied main N dressing to block 5 as Nitro-chalk,	350	seeds/m^2
03-Jun-13	p	Sprayed Ally Max, Folicur and Amistar to spring rye only	42 0.5 0.5	
01-Sep-13	a	Cut plots for yield	—	—
04-Sep-13	a	Combined	—	—
06-Sep-13	a	Baled	—	—

S Oats

14-Mar-13	s	Drilled Circle tr Kinto, spring oats. Plots 1,2,15,16,19,20,27 and 28	350	seeds/m^2 kg/ha
22-Apr-13	f	Applied Nitram, applied to plots 1,2,15,16,19,20,27,28,35,36,39,40,45,46,47,48.	290	l/ha l/ha l/ha
02-Jun-13	p	Sprayed Cello, Foundation and Hatchet Xtra, sprayed oats only	Ce 0.8 Fo1.25 Ha 0.5	l/ha
05-Jul-13	p	Sprayed Cello, sprayed oats only	0.55	
01-Sep-13	a	Cut plots for yield	—	—
04-Sep-13	a	Combined	—	—
06-Sep-13	a	Baled	—	—

NOTE: All crops (wheat, rye, beans and oats) were spring varieties in 2013 because they were late sown due to the very wet autumn and spring weather. Herbage and grain samples were taken for chemical analyses.

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LEYS

1ST CUT (1/7/13) DRY MATTER TONNES/HECTARE

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

FYM_RES

LEY	NONE	FYM	MEAN
LC1	0.00	0.00	0.00
LC2	5.39	5.08	5.24
LC3	5.44	6.02	5.73
LN1	0.00	0.00	0.00
LN2	6.29	5.71	6.00
LN3	6.10	5.37	5.74
(LLC/LC)LC1	0.00	0.00	0.00
(LLC/LC)LC2	5.53	4.70	5.11
(LLC/LC)LC3	7.16	6.45	6.81
(LLN/LN)LN1	0.00	0.00	0.00
(LLN/LN)LN2	6.65	8.14	7.40
(LLN/LN)LN3	6.40	5.34	5.87

1ST CUT MEAN DM% 31.7

13/W/RN/3

2ND CUT (13/11/13) DRY MATTER TONNES/HECTARE

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

FYM_RES

LEY	NONE	FYM	MEAN
LC1	0.35	0.39	0.37
LC2	0.18	0.13	0.15
LC3	0.00	0.00	0.00
LN1	1.22	1.04	1.13
LN2	0.15	0.22	0.19
LN3	0.00	0.00	0.00
(LLC/LC)LC1	0.63	0.88	0.75
(LLC/LC)LC2	0.11	0.43	0.27
(LLC/LC)LC3	0.00	0.00	0.00
(LLN/LN)LN1	0.75	1.14	0.94
(LLN/LN)LN2	0.82	0.65	0.74
(LLN/LN)LN3	0.00	0.00	0.00

2ND CUT MEAN DM% 19.4

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TOTAL OF 2 CUTS DRY MATTER TONNES/HECTARE

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

FYM_RES			
LEY	NONE	FYM	MEAN
LC1	0.35	0.39	0.37
LC2	5.57	5.21	5.39
LC3	5.44	6.02	5.73
LN1	1.22	1.04	1.13
LN2	6.45	5.93	6.19
LN3	6.10	5.37	5.74
(LLC/LC)LC1	0.63	0.88	0.75
(LLC/LC)LC2	5.64	5.13	5.38
(LLC/LC)LC3	7.16	6.45	6.81
(LLN/LN)LN1	0.75	1.14	0.94
(LLN/LN)LN2	7.48	8.80	8.14
(LLN/LN)LN3	6.40	5.34	5.87

TOTAL OF 2 CUTS MEAN DM% 26.0

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13/W/RN/3

ARABLE TREATMENT CROPS

BEANS

GRAIN (85% DRY MATTER) TONNES/HECTARE

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

FYMRES ROTATION	NONE	FYM	Mean
(AO)Be	0.27	0.39	0.33
(LLn/AO)Be	1.11	1.30	1.21
(LLc/ABe)Be	1.07	1.05	1.06
(ABe)Be	0.86	0.97	0.92
Mean	0.83	0.93	0.88

GRAIN MEAN DM% 87.7

PLOT AREA HARVESTED 0.00413

OATS

GRAIN85% GRAIN (AT 85% DRY MATTER) TONNES/HECTARE

***** TABLES OF MEANS *****

ROTATION	NONE	FYM	MEAN
ABe	3.64	3.79	3.71
AO	4.86	4.30	4.58
LLc/ABe	5.02	4.30	4.66
LLn/AO	5.31	5.24	5.28

GRAIN MEAN DM% 87.6

PLOT AREA HARVESTED 0.00413

RYE

GRAIN (85% DRY MATTER) TONNES/HECTARE

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

FYMRES ROTATION	NONE	FYM	Mean
(ABe)R	4.69	5.48	5.08
(AO)R	4.27	5.12	4.69
(LLn/AO)R	4.37	5.02	4.70
(LLc/ABe)R	5.67	5.62	5.65
Mean	4.75	5.31	5.03

GRAIN MEAN DM% 85.8

PLOT AREA HARVESTED 0.00413

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13/W/RN/3

W. WHEAT

Grain tonnes/hectare

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

FYMRES	none	FYM	Mean
ROTATION			
(AO)W	5.14	4.55	4.85
(ABe)W	5.10	4.95	5.03
(LLn/AO)W	5.13	5.42	5.27
(LLc/ABe)W	5.14	4.92	5.03
(LN)W	4.41	3.60	4.00
(LLN/Ln)W	4.09	4.70	4.40
(LC)W	3.12	3.18	3.15
(LLc/Lc)W	4.02	3.46	3.74
Mean	4.52	4.35	4.43

N	0	80	160	240	Mean
ROTATION					
(AO)W	2.50	5.23	5.72	5.93	4.85
(ABe)W	3.91	5.40	5.64	5.16	5.03
(LLn/AO)W	3.61	6.20	5.66	5.62	5.27
(LLc/ABe)W	3.78	5.73	5.20	5.41	5.03
(LN)W	3.56	2.77	5.49	4.20	4.00
(LLN/Ln)W	4.06	4.61	4.82	4.10	4.40
(LC)W	3.61	2.26	2.95	3.78	3.15
(LLc/Lc)W	4.03	3.53	3.92	3.48	3.74
Mean	3.63	4.47	4.92	4.71	4.43

N	0	80	160	240	Mean
FYMRES					
none	3.71	4.51	5.09	4.76	4.52
FYM	3.55	4.42	4.76	4.66	4.35
Mean	3.63	4.47	4.92	4.71	4.43

N	0	80	160	240
ROTATION FYMRES				
(AO)W none	2.72	5.38	6.33	6.13
FYM	2.29	5.08	5.10	5.74
(ABe)W none	3.81	5.74	5.91	4.96
FYM	4.00	5.07	5.38	5.37
(LLn/AO)W none	3.11	6.39	5.23	5.77
FYM	4.11	6.01	6.08	5.48
(LLc/ABe)W none	3.88	5.77	5.21	5.71
FYM	3.68	5.69	5.18	5.11
(LN)W none	4.21	3.91	5.77	3.75
FYM	2.91	1.63	5.20	4.66
(LLN/Ln)W none	3.79	3.88	4.28	4.43
FYM	4.33	5.35	5.36	3.77
(LC)W none	3.98	2.38	2.94	3.19
FYM	3.24	2.15	2.95	4.36
(LLc/Lc)W none	4.21	2.67	5.05	4.16
FYM	3.86	4.39	2.79	2.79

GRAIN MEAN DM% 87.0

PLOT AREA HARVESTED 0.00192

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13/W/RN/3

W. RYE

Grain tonnes/hectare

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

FYMRES	none	FYM	Mean
ROTATION			
(AO)R	4.16	4.08	4.12
(ABe)R	3.84	4.43	4.14
(LLn/AO)R	5.04	4.65	4.85
(LLc/ABe)R	4.58	4.79	4.68
(Ln)R	2.98	4.03	3.50
(LLn/Ln)R	3.32	4.60	3.96
(Lc)R	4.22	4.10	4.16
(LLc/Lc)R	4.33	4.71	4.52
Mean	4.06	4.42	4.24

ROTATION					
(AO)R	2.81	4.07	4.59	5.02	4.12
(ABe)R	2.38	3.84	4.90	5.43	4.14
(LLn/AO)R	3.35	5.00	5.36	5.67	4.85
(LLc/ABe)R	2.82	4.58	5.59	5.73	4.68
(Ln)R	2.78	3.32	3.83	4.09	3.50
(LLn/Ln)R	3.25	2.69	5.56	4.33	3.96
(Lc)R	2.85	4.22	4.85	4.72	4.16
(LLc/Lc)R	3.27	4.53	4.77	5.52	4.52
Mean	2.94	4.03	4.93	5.06	4.24

N	0	50	100	150	Mean
FYMRES					
none	2.79	3.76	4.75	4.94	4.06
FYM	3.09	4.30	5.11	5.19	4.42
Mean	2.94	4.03	4.93	5.06	4.24

N	0	50	100	150
ROTATION FYMRES				
(AO)R none	2.88	4.04	4.58	5.14
(AO)R FYM	2.74	4.11	4.59	4.90
(ABe)R none	2.17	3.38	4.70	5.12
(ABe)R FYM	2.58	4.29	5.09	5.74
(LLn/AO)R none	3.23	5.26	5.99	5.70
(LLn/AO)R FYM	3.47	4.74	4.74	5.64
(LLc/ABe)R none	2.88	4.28	5.54	5.61
(LLc/ABe)R FYM	2.77	4.89	5.64	5.86
(Ln)R none	2.09	2.94	2.99	3.90
(Ln)R FYM	3.46	3.70	4.66	4.29
(LLn/Ln)R none	2.95	1.93	4.93	3.48
(LLn/Ln)R FYM	3.56	3.46	6.20	5.18
(Lc)R none	2.61	4.26	4.85	5.16
(Lc)R FYM	3.08	4.17	4.85	4.29
(LLc/Lc)R none	3.50	4.02	4.44	5.39
(LLc/Lc)R FYM	3.05	5.04	5.11	5.66

GRAIN MEAN DM% 85.4

PLOT AREA HARVESTED 0.00192

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