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Yields of the Field Experiments 2003

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Results of the
Classical
and other
Long-term Experiments
2003

Rothamsted Research

03/W/RN/3 - Woburn Ley Arable

Rothamsted Research

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03/W/RN/3

LEY/ARABLE

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

Sponsor: P.R. Poulton.

The 66th year, leys, w. beans, w. wheat, w. rye, forage maize.

For previous years see 'Details' 1967 & 1973 and 74-02/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 1998 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

03/W/RN/3

ROTATION (continued)

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

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.

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
AM
ABe

1/2 plots:

2. **NSPLIT(FYM res)** Farmyard manure residues, last applied 1963:

Nsplit(noFYM)
Nsingle(FYM)

1/8 plots:

3. **N** Nitrogen fertilizer in spring 2003 (kg N) as 27% N:

0			
70	)as a	40 + 30	)split dressings
140	)single	OR 40 + 100	)late Feb/early Mar
210	)dressing	40 + 170	)and GS31 or mid-Apr

03/W/RN/3

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

Whole plots:

1. ROTATION Rotations before first test crop:

LLN 8
LN 3
LLC 8
LC 3
AF
AB

1/2 plots:

2. NSPLIT(FYM res) Farmyard manure residues, last applied 1967:

Nsplit to wheat in 2002(noFYM)
Nsingle to wheat in 2002 (FYM)

1/8 plots:

3. N Nitrogen fertilizer in spring 2003(kg N) as 27% N:

0
40
80
120

Treatments to leys:

FYM RES Farmyard manure residues:

NONE
FYM 38 t on each occasion, last applied 1966 to 1st
and 6th year leys, 1965 to 2nd and 7th year leys, 1964
to 3rd and 8th year leys, 1963 to 4th year leys, 1967
to 5th year leys.

NOTE: Corrective K dressings (kg K₂O) as muriate of potash, applied where
necessary to first test crop w. wheat and long-term leys in the
wheat block, applied 20th September 2002.

Continuous rotations before wheat	No FYM half plots	FYM half plots
ABe	250	250
AM	250	250

None to other plots.

03/W/RN/3

Experimental diary:

Grass ley and clover/grass ley, 1st year (ROTATION LN1, LLN1, LC1, and LLC1)

19-Sep-02 CleanCrop Egret at 4.0 l in 200 l.
 20-Sep-02 Triplesuperphosphate at 213 kg
 26-Sep-02 Chalk at 5.0 t.
 01-Oct-02 Ploughed and rolled.
 04-Oct-02 Drilled Promesse Timothy + Senu Fescue, 50:50, @ 30 kg and
 Promesse Timothy + Senu Fescue + Merwi White Clover,
 45:45:10 @ 30 kg with 4.0 m Accord drill. Rolled.
 04-Oct-02 27.0% N at 93 kg, 1st year grass/clover leys; at 185 kg, 1st
 year grass leys.
 03-Apr-03 Potassium sulphate at 140 kg.
 Muriate of potash at 167 kg.
 15-May-03 Setter 33 at 5.0 l in 200 l.
 19-Jun-03 Cut yield strips, weighed and sampled.
 Mowed for hay.
 20-Jun-03 Tedded hay.
 21-Jun-03 Tedded hay.
 25-Jun-03 Tedded hay.
 26-Jun-03 Baled hay.
 01-Jul-03 Topped to tidy.
 04-Jul-03 Muriate of potash at 83 kg.
 10-Oct-03 Topped.

Grass leys 2nd to 8th year (ROTATION LN2-3 and LLN2-8)

03-Apr-03 Potassium sulphate at 140 kg,
 Triple superphosphate at 213 kg.
 Muriate of potash at 167 kg.
 04-Apr-03 33.5% N at 224 kg
 15-May-03 Setter 33 at 5.0 l in 200 l.
 19-Jun-03 Cut yield strips, weighed and sampled.
 Mowed for hay.
 20-Jun-03 Tedded hay.
 21-Jun-03 Tedded hay.
 25-Jun-03 Tedded hay.
 26-Jun-03 Baled hay.
 04-Jul-03 Muriate of potash at 83 kg.
 34.5% N at 217 kg.
 22-Sep-03 2nd cut yield strips, weighed and sampled.

Clover/grass leys 2nd to 8th year (ROTATION LC2-3 and LLC2-8)

03-Apr-03 Potassium sulphate at 140 kg,
 Triple superphosphate at 213 kg.
 Muriate of potash at 167 kg.
 15-May-03 Setter 33 at 5.0 l in 200 l.
 19-Jun-03 Cut yield strips, weighed and sampled.
 Mowed for hay.
 20-Jun-03 Tedded hay.
 21-Jun-03 Tedded hay.
 25-Jun-03 Tedded hay.
 26-Jun-03 Baled hay.
 01-Jul-03 Topped to tidy.
 04-Jul-03 Muriate of potash at 83 kg.
 22-Sep-03 2nd cut yield strips, weighed and sampled.

W. beans, 2nd and 3rd treatment crop (ROTATION AM and ABe)

20-Sep-02 Triple superphosphate at 127 kg.
 20-Dec-02 Broadcast, Clipper, recleaned at 28 seeds/m² by hand.
 Ploughed 35 cm furrows.
 17-Feb-03 Gesatop at 2.0 l in 200 l.
 03-Apr-03 Potassium sulphate at 140 kg
 07-May-03 tm) Laser at 1.0 l in 200 l.

tm)Hallmark with Zeon Technology at 75 ml in 200 l.
tm)Amber at 1.0 l in 200 l.

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Experimental diary:

W. beans, 2nd and 3rd treatment crop (**ROTATION** AM and ABe)
 09-Jun-03 tm)Clayton Turret at 1.5 l in 200 l.
 tm)Amistar at 0.5 l in 200 l.
 10-Aug-03 Combine harvested plots for yield, combined discards. Straw
 swathed.
 13-Aug-03 Straw baled and removed.
Forage maize, 2nd and 3rd treatment crop (**ROTATION** Abe and AM)
 20-Sep-02 Triple superphosphate at 127 kg.
 03-Apr-03 Potassium sulphate at 140 kg
 12-May-02 Power harrowed. Drilled, Hudson, tr. Mesuro1, at 10.2
 seeds/m² with the Nodet drill.
 29-May-03 27% N at 370 kg.
 13-Jun-03 tm)Gesaprim at 3.0 l in 200 l.
 tm)Phase II at 2.0 l in 200 l.
 27-Aug-03 Cut sampled and weighted.
 04-Sep-03 Cut discards.
W. wheat, 1st test crop (W)
 19-Sep-02 CleanCrop Egret at 4.0 l in 200 l.
 20-Sep-02 Muriate of potash (corrective K) by hand at 250 kg K₂O to
 plots 53, 54, 63, 64.
 Triple superphosphate at 127 kg.
 17-Oct-02 Ploughed 35 cm furrows.
 18-Oct-02 Power harrowed, drilled Claire, tr. Sibutol, at 350 seeds/m²
 with the Accord drill. Rolled.
 26-Nov-02 tm)Lexus Class WSB at 60 g in 200 l.
 tm)Hallmark with Zeon Technology at 25 ml in 200 l.
 07-Mar-03 1st N (27% N) applied to split N sub-plots.
 02-Apr-03 27% N to single application plots
 13-Mar-03 Dursban 4 at 1.0 l in 200 l
 03-Apr-03 Potassium sulphate at 140 kg
 06-May-03 Opus at 0.75 l in 200 l.
 2nd (27% N) applied to split N sub-plots.
 07-May-03 Ally at 30 g in 200 l.
 09-Jun-03 Landmark at 0.75 l in 200 l.
 10-Aug-03 Combine harvested plots for yield, combined discards. Straw
 swathed.
 11-Aug-03 Cut straw. Sampled and weighed straw.
 13-Aug-03 Straw baled and removed.
W. rye, 2nd test crop and 1st treatment crop (**ROTATION** Abe and AM)
 20-Sep-02 Triple superphosphate at 127 kg.
 26-Sep-02 Chalk at 5.0 t.
 02-Oct-02 Ploughed and rolled.
 18-Oct-02 Power harrowed. Drilled, Picasso/Nikita blend (90:10), tr.
 Baytan, at 98 seeds/m² with 4.0 m Accord drill. Rolled.
 26-Nov-02 tm)Lexus Class WSB at 60 g in 200 l.
 tm)Hallmark with Zeon Technology at 25 ml in 200 l.
 02-Apr-03 27% N at 296 kg to 2nd test crop only.
 03-Apr-03 Potassium sulphate at 140 kg
 04-Apr-03 33.5% N at 239 kg to treatment crop only.
 06-May-03 Opus at 0.75 l in 200 l.
 07-May-03 Quantum 75 DF at 20 g in 200 l.
 10-Aug-03 Combine harvested plots for yield, combined discards. Straw
 swathed.
 11-Aug-03 Cut straw. Sampled and weighed straw.
 13-Aug-03 Straw baled and removed.

NOTE: (1) Because of operational difficulties while harvesting the straw
 yields of 2 plots were lost, with treatment combination LLC 8 FYM
 N60 and LLC 8 NONE N0. Estimated values are presented in the
 table.

03/W/RN/3

LEYS

1ST CUT (19/6/03) DRY MATTER TONNES/HECTARE

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

FYM RES	NONE	FYM	Mean
LEY			
LC1	0.95	1.11	1.03
LC2	3.22	3.19	3.20
LC3	4.28	4.62	4.45
LN1	5.58	4.67	5.12
LN2	3.96	3.85	3.91
LN3	5.60	5.61	5.60
LLC1	2.21	2.17	2.19
LLC2	3.43	2.98	3.21
LLC3	5.24	4.80	5.02
LLC4	6.03	5.89	5.96
LLC5	7.00	7.05	7.02
LLC6	4.78	4.88	4.83
LLC7	2.73	1.72	2.23
LLC8	1.76	2.27	2.02
LLN1	6.80	6.22	6.51
LLN2	5.19	5.58	5.39
LLN3	5.64	5.20	5.42
LLN4	7.99	6.70	7.34
LLN5	6.19	6.56	6.37
LLN6	6.52	6.14	6.33
LLN7	4.74	5.74	5.24
LLN8	5.98	5.80	5.89
Mean	4.81	4.67	4.74

1ST CUT MEAN DM% 35.2

03/W/RN/3

LEYS

2ND CUT (22/9/03) DRY MATTER TONNES/HECTARE

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

FYM RES	NONE	FYM	Mean
LEY			
LC1	0.00	0.00	0.00
LC2	0.00	0.00	0.00
LC3	0.15	0.34	0.25
LN1	0.00	0.00	0.00
LN2	0.00	0.00	0.00
LN3	0.83	0.92	0.88
LLC1	0.00	0.00	0.00
LLC2	0.00	0.00	0.00
LLC3	0.00	0.00	0.00
LLC4	0.00	0.00	0.00
LLC5	0.00	0.00	0.00
LLC6	0.00	0.00	0.00
LLC7	0.00	0.00	0.00
LLC8	0.05	0.08	0.06
LLN1	0.00	0.00	0.00
LLN2	0.00	0.00	0.00
LLN3	0.00	0.00	0.00
LLN4	0.00	0.00	0.00
LLN5	0.00	0.00	0.00
LLN6	0.00	0.00	0.00
LLN7	0.00	0.00	0.00
LLN8	0.69	0.83	0.76
Mean	0.08	0.10	0.09

2ND CUT MEAN DM% (OF 8 NON ZERO PLOTS) 51.0

03/W/RN/3

LEYS

TOTAL OF 2 CUTS DRY MATTER TONNES/HECTARE

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

FYM RES	NONE	FYM	Mean
LEY			
LC1	0.95	1.11	1.03
LC2	3.22	3.19	3.20
LC3	4.43	4.96	4.69
LN1	5.58	4.67	5.12
LN2	3.96	3.85	3.91
LN3	6.43	6.53	6.48
LLC1	2.21	2.17	2.19
LLC2	3.43	2.98	3.21
LLC3	5.24	4.80	5.02
LLC4	6.03	5.89	5.96
LLC5	7.00	7.05	7.02
LLC6	4.78	4.88	4.83
LLC7	2.73	1.72	2.23
LLC8	1.81	2.35	2.08
LLN1	6.80	6.22	6.51
LLN2	5.19	5.58	5.39
LLN3	5.64	5.20	5.42
LLN4	7.99	6.70	7.34
LLN5	6.19	6.56	6.37
LLN6	6.52	6.14	6.33
LLN7	4.74	5.74	5.24
LLN8	6.66	6.63	6.65
Mean	4.89	4.77	4.83

TOTAL OF 2 CUTS MEAN DM% 36.7

PLOT AREA HARVESTED 0.00200

03/W/RN/3

MAIZE

WHOLE CROP (100% DRY MATTER) TONNES/HECTARE

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

FYMRES	NONE	FYM	Mean
ROTATION			
AM	9.09	8.94	9.02
AB	10.06	9.28	9.67
Mean	9.58	9.11	9.34

GRAIN MEAN DM% 33.7

PLOT AREA HARVESTED 0.00108

W. BEANS

GRAIN (85% DRY MATTER) TONNES/HECTARE

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

FYMRES	
NONE	1.66
FYM	1.69
Mean	1.67

GRAIN MEAN DM% 91.1

PLOT AREA HARVESTED 0.00413

03/W/RN/3

W. WHEAT

GRAIN TONNES/HECTARE

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

NSPLITFYM	N		N		Mean
ROTATION	0		70		Mean
LLN 8	5.56		6.05		5.80
LN 3	6.00		6.11		6.05
LLC 8	6.83		6.79		6.81
LC 3	7.81		7.56		7.68
AM	6.15		6.30		6.22
ABe	6.74		7.05		6.89
Mean	6.51		6.64		6.58
NSPLITFYM	N		N		Mean
ROTATION	0		70		Mean
LLN 8	4.01		6.32		5.80
LN 3	3.93		5.87		6.05
LLC 8	5.18		6.77		6.81
LC 3	5.59		7.66		7.68
AM	2.17		5.87		6.22
ABe	3.04		6.84		6.89
Mean	3.99		6.55		6.58
NSPLITFYM	N		N		Mean
ROTATION	0		70		Mean
Nsplit(noFYM)	3.85		6.44		6.51
Nsingle(FYM)	4.13		6.67		6.64
Mean	3.99		6.55		6.58
NSPLITFYM	N		N		Mean
ROTATION	0		70		Mean
LLN 8Nsplit(noFYM)	3.78		6.32		5.28
LLN 8Nsingle(FYM)	4.24		6.31		7.08
LN 3Nsplit(noFYM)	4.05		6.00		7.73
LN 3Nsingle(FYM)	3.82		5.73		7.60
LLC 8Nsplit(noFYM)	5.04		6.76		8.15
LLC 8Nsingle(FYM)	5.32		6.78		7.67
LC 3Nsplit(noFYM)	5.43		7.25		8.80
LC 3Nsingle(FYM)	5.75		8.06		8.06
AMNsplit(noFYM)	1.90		5.81		8.51
AMNsingle(FYM)	2.45		5.94		8.58
ABeNsplit(noFYM)	2.92		6.47		8.85
ABeNsingle(FYM)	3.17		7.22		8.91

GRAIN MEAN DM% 91.3

03/W/RN/3

W. WHEAT

STRAW TONNES/HECTARE

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

NSPLITFYM	Nsplit(noFYM)	Nsingle(FYM)	Mean		
ROTATION					
LLN 8	2.49	2.47	2.48		
LN 3	2.00	2.24	2.12		
LLC 8	2.70	3.19	2.95		
LC 3	3.28	3.50	3.39		
AM	1.87	3.03	2.45		
ABe	2.45	2.84	2.64		
Mean	2.46	2.88	2.67		
N	0	70	140	210	Mean
ROTATION					
LLN 8	1.20	3.05	2.55	3.12	2.48
LN 3	1.14	2.05	2.67	2.62	2.12
LLC 8	1.66	2.76	3.49	3.87	2.95
LC 3	1.91	3.64	4.01	3.99	3.39
AM	1.72	1.91	3.07	3.09	2.45
ABe	1.26	2.24	3.17	3.91	2.64
Mean	1.48	2.61	3.16	3.43	2.67
N	0	70	140	210	Mean
NSPLITFYM					
Nsplit(noFYM)	1.33	2.48	3.06	2.98	2.46
Nsingle(FYM)	1.63	2.74	3.26	3.88	2.88
Mean	1.48	2.61	3.16	3.43	2.67
N					
0 70 140 210					
ROTATION NSPLITFYM					
LLN 8	Nsplit(noFYM)	1.53	3.08	2.88	2.44
	Nsingle(FYM)	0.86	3.01	2.21	3.80
LN 3	Nsplit(noFYM)	1.17	1.83	2.27	2.73
	Nsingle(FYM)	1.11	2.26	3.07	2.51
LLC 8	Nsplit(noFYM)	1.60	2.76	3.11	3.32
	Nsingle(FYM)	1.72	2.76	3.88	4.41
LC 3	Nsplit(noFYM)	1.85	3.69	3.83	3.73
	Nsingle(FYM)	1.97	3.59	4.19	4.25
AM	Nsplit(noFYM)	0.49	1.60	3.09	2.28
	Nsingle(FYM)	2.95	2.21	3.05	3.89
ABe	Nsplit(noFYM)	1.35	1.91	3.16	3.38
	Nsingle(FYM)	1.17	2.58	3.18	4.43

STRAW MEAN DM% 95.5

Plot area harvested 0.00183

03/W/RN/3

W. RYE

GRAIN TONNES/HECTARE

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

FYMRES65 ROTATION	NONE	FYM	Mean
LLN 8	6.41	6.23	6.32
LN 3	6.24	6.65	6.44
LLC 8	6.13	5.84	5.99
LC 3	5.83	6.26	6.05
AM	3.84	3.31	3.58
ABe	4.64	5.25	4.95
Mean	5.51	5.59	5.55

	N	0	40	80	120	Mean
ROTATION						
LLN 8		4.18	6.10	7.37	7.64	6.32
LN 3		4.21	6.14	7.74	7.68	6.44
LLC 8		4.20	5.48	6.41	7.84	5.99
LC 3		3.42	5.64	7.37	7.75	6.05
AM		1.48	2.89	4.37	5.57	3.58
ABe		2.36	4.46	5.99	6.97	4.95
Mean		3.31	5.12	6.54	7.24	5.55

	N	0	40	80	120	Mean
FYMRES65						
NONE		3.23	4.97	6.65	7.21	5.51
FYM		3.39	5.27	6.44	7.27	5.59
Mean		3.31	5.12	6.54	7.24	5.55

		N	0	40	80	120
ROTATION	FYMRES65					
LLN 8	NONE		3.80	6.71	7.83	7.29
	FYM		4.56	5.49	6.90	7.98
LN 3	NONE		3.98	5.84	7.99	7.14
	FYM		4.43	6.45	7.50	8.22
LLC 8	NONE		4.04	5.55	6.17	8.77
	FYM		4.37	5.42	6.66	6.92
LC 3	NONE		3.14	4.58	7.71	7.89
	FYM		3.70	6.69	7.03	7.61
AM	NONE		2.12	3.01	4.43	5.79
	FYM		0.84	2.76	4.31	5.35
ABe	NONE		2.28	4.12	5.77	6.39
	FYM		2.43	4.80	6.21	7.56

GRAIN MEAN DM% 90.4

03/W/RN/3

W. RYE

STRAW TONNES/HECTARE

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

FYMRES65	NONE	FYM	Mean
ROTATION			
LLN 8	3.57	3.61	3.59
LN 3	3.41	3.93	3.67
LLC 8	3.39	3.24	3.31
LC 3	3.12	3.35	3.24
AM	2.17	2.37	2.27
ABe	2.38	2.80	2.59
Mean	3.01	3.22	3.11

N	0	40	80	120	Mean
ROTATION					
LLN 8	2.26	3.38	4.21	4.51	3.59
LN 3	2.33	3.56	4.50	4.29	3.67
LLC 8	2.23	2.62	3.66	4.75	3.31
LC 3	1.58	2.95	3.87	4.56	3.24
AM	1.91	1.49	2.18	3.52	2.27
ABe	1.09	2.49	3.18	3.59	2.59
Mean	1.90	2.75	3.60	4.20	3.11

N	0	40	80	120	Mean
FYMRES65					
NONE	1.57	2.76	3.70	4.01	3.01
FYM	2.23	2.74	3.50	4.40	3.22
Mean	1.90	2.75	3.60	4.20	3.11

	N	0	40	80	120
ROTATION					
LLN 8	FYMRES65				
	NONE	2.01	3.84	4.27	4.16
LN 3	FYM	2.50	2.92	4.15	4.86
	NONE	2.05	3.33	4.67	3.60
LLC 8	FYM	2.61	3.79	4.33	4.99
	NONE	2.08	2.81	3.66	5.01
LC 3	FYM	2.37	2.43	3.66	4.49
	NONE	1.34	2.80	4.28	4.08
AM	FYM	1.82	3.11	3.46	5.03
	NONE	0.97	1.51	2.31	3.89
ABe	FYM	2.84	1.46	2.04	3.14
	NONE	0.97	2.26	2.99	3.29
	FYM	1.21	2.73	3.37	3.88

STRAW MEAN DM% 94.5

PLOT AREA HARVESTED 0.00183