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Yields of the Field Experiments

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19/W/RN/3 - Ley/ARABLE (Stackyard D, Woburn Farm)

Rothamsted Research

Rothamsted Research (2021) *19/W/RN/3 - Ley/ARABLE (Stackyard D, Woburn Farm) ;* Yields Of The Field Experiments , pp 32 - 46 **- DOI: https://doi.org/10.23637/ERADOC-1-257**

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19/W/RN/3 LEY/ARABLE (Stackyard D, Woburn Farm)

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

Sponsors: A. J. Macdonald

The 82nd year, leys, winter beans, winter wheat, winter rye

For previous years see 'Details' 1967 & 1973 and Yield Books for 74-18/W/RN/3.

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

Whole plot dimensions: 8.53 m x 40.7 m

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, WINTER
A	Arable with roots:	P, R, C, P, W until 1971 then P, B, B, P, WINTER
A H	Arable with hay:	P, R, H, P, W until 1971 then P, B, H, P, WINTER

P = potatoes, R = winter rye, C = carrots, W= winter wheat, B = spring 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 every 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 (spring 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 leys 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 winter rye (R) replaced spring 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. The new rotations were fully in phase by 2016.

Treatments to first test crop winter wheat, all combinations of:

Whole plots:

1. **ROTATION** Rotations before wheat:

LLN 8
LN 3
LLC 8
LC 3
LLC/LC3
LLN/LN3
LLN/AO
LLC/ABe
AM/AO
ABe

1/ 2 plots:

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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:

3. **N** Nitrogen fertilizer as split dressings in spring 2019 (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 winter 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 2019 (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.

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NOTE: Corrective K dressings (kg K_2O ha^{-1}) as muriate of potash, applied where necessary to first test crop winter wheat and long-term leys in the wheat block, applied 2018 (see date below).

Continuous rotations	No FYM	FYM Res
Before wheat	Half plots	Half plots
ABe/Be	330	310
AO/O	300	300
LLn/AO	210	180
LLc/ABe	220	160

None to other plots.

Experimental Diary

Date		Application	Rate	Units
ALL				
24/09/2018	a	Ploughing	-	-
01/04/2019	a	Cultivated with power-harrow	-	-
01/04/2019	a	Rolling	-	-
16/04/2019	a	Topping paths	-	-
21/05/2019	a	Topped paths	-	-
28/06/2019	a	Topped paths	-	-
15/07/2019	a	Baling	-	-
15/07/2019	a	Rowing up	-	-
20/09/2019	a	Rowing up	-	-
21/09/2019	a	Baling	-	-
24/09/2019	a	Topping	-	-
Grass ley and clover/grass leys (first year leys)				
17/10/2018	a	Topping grass	-	-
14/11/2018	f	Applied SOP (50% K2O, 45% SO3); Block 5; Plots 65, 66, 69, 70, 77, 78, 79, 80	140	kg/ha
14/11/2018	f	Applied TSP (46% P2O5); Block 5; Plots 65, 66, 69, 70, 77, 78, 79, 80	213	kg/ha
01/04/2019	a	Seeded by hand - grass only; Plots 65, 66, 69, 70	30	kg/ha

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01/04/2019	a	Seeded by hand - grass/clover only; Plots 77 to 80	30	kg/ha
18/04/2019	f	Applied Nitram (34.5% N) - grass only; Block 5; Plots 65, 66, 69, 70	217	kg/ha
18/04/2019	f	Applied MOP (60% K2O); Block 5; Plots 65, 66, 69, 70, 77, 78, 79, 80	167	kg/ha
24/04/2019	f	Applied Nitram (34.5% N) - grass only; Block 5; Plots 65, 66, 69, 70	145	kg/ha
24/04/2019	f	Applied Nitram (34.5% N) - grass/clover only; Block 5; Plots 77 to 80	72	kg/ha
02/07/2019	a	1st Cut	-	-
06/11/2019	a	2nd Cut	-	-
Grass ley and clover/grass leys (2nd and 3rd year leys)				
17/10/2018	a	Topping grass	-	-
14/11/2018	f	Applied SOP (50% K2O, 45% SO3); Blocks 1 and 3; Plots 3, 4, 7, 8, 11, 12, 13, 14, 33, 34, 37, 38, 41, 42, 43, 44	140	kg/ha
14/11/2018	f	Applied TSP (46% P2O5); Blocks 1 and 3; Plots 3, 4, 7, 8, 11, 12, 13, 14, 33, 34, 37, 38, 41, 42, 43, 44	213	kg/ha
18/04/2019	f	Applied Nitram (34.5% N) - grass only; Plots 11 to 14, 37, 38, 43, 44	217	kg/ha
18/04/2019	f	Applied MOP (60% K2O) - grass only; Plots 3, 4, 7, 8, 11 to 14, 33, 34, 37, 38, 41 to 44.	167	kg/ha
02/07/2019	a	1st Cut	-	-
06/11/2019	a	2nd Cut	-	-
W Beans				
14/11/2018	f	Applied TSP (46% P2O5); Plots 1, 2 15, 16, 35, 36, 39, 40	127	kg/ha
16/11/2018	a	Drilled Tundra	50	seeds/m^2
18/04/2019	f	Applied SOP (50% K2O, 45% SO3); Plots 1, 2 15, 16, 35, 36, 39, 40	150	kg/ha
23/04/2019	p	Sprayed bassagran onto beans	1.65	kg/ha
20/06/2019	p	Sprayed Sprinter	3	lt/ha
20/06/2019	p	Sprayed San 703	703	lt/ha

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18/09/2019	a	Harvested all Plots - no yields due to insufficient material; odds & ends cleared	-	-
W Wheat				
14/11/2018	f	Applied TSP (46% P2O5); Block 1; Plots 17 to 32	127	kg/ha
14/11/2018	f	Applied MOP (60% K2O) as corrective K; plot 21	160	kg/ha
14/11/2018	f	Applied MOP (60% K2O) as corrective K; plot 28	180	kg/ha
14/11/2018	f	Applied MOP (60% K2O) as corrective K; plot 27	210	kg/ha
14/11/2018	f	Applied MOP (60% K2O) as corrective K; plot 22	220	kg/ha
14/11/2018	f	Applied MOP (60% K2O) as corrective K; Plots 19, 20	300	kg/ha
14/11/2018	f	Applied MOP (60% K2O) as corrective K; plot 18	310	kg/ha
14/11/2018	f	Applied MOP (60% K2O) as corrective K; plot 17	330	kg/ha
15/11/2018	a	Drilled Crusoe trt Redigo Pro	400	seeds/m^2
18/03/2019	f	Applied Nitro-Chalk (27% N) excludes Plots 174, 183, 193, 201, 212, 221, 231, 242, 252, 262, 274, 282, 292, 304, 311, 323	148	kg/ha
16/04/2019	f	Applied Nitro-Chalk (27% N) by hand; Plots 171 ,182 ,194 ,204 ,214 ,223 ,234 ,241 ,251 ,263 ,272 ,283 ,294 ,303 ,314 ,321	148	kg/ha
16/04/2019	f	Applied Nitro-Chalk (27% N) by hand; Plots 172 ,184 ,191 ,202 ,211 ,222 ,232 ,243 ,254 ,261 ,273 ,281 ,291 ,301 ,313 ,324	444	kg/ha
16/04/2019	f	Applied Nitro-Chalk (27% N) by hand; Plots 173 ,181 ,192 ,203 ,213 ,224 ,233 ,244 ,253 ,264 ,271 ,284 ,293 ,302 ,312 ,322	741	kg/ha
18/04/2019	f	Applied SOP (50% K2O, 45% SO3); Plots 171 ,182 ,194 ,204 ,214 ,223 ,234 ,241 ,251 ,263 ,272 ,283 ,294 ,303 ,314 ,321	150	kg/ha
29/04/2019	p	Sprayed Ally Max	42	g/ha
29/04/2019	p	Sprayed Hurler	500	ml/ha

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29/04/2019	p	Sprayed Sprinter	2	lt/ha
29/04/2019	p	Sprayed Envoy	1	lt/ha
29/05/2019	p	Sprayed Sprinter	3	lt/ha
29/05/2019	p	Sprayed Cello	1.25	lt/ha
18/09/2019	a	Harvested all Plots; odds & ends cleared	-	-

W Rye

14/09/2018	f	Applied chalk treatments; Block 4	5	t/ha
14/11/2018	f	Applied TSP (46% P2O5); Plots 49 to 64 (Block 4), 67, 68, 71 to 76	127	kg/ha
15/11/2018	a	Drilled Mephisto	350	seeds/m^2
16/04/2019	f	Applied Nitro-Chalk (27% N) by hand; Plots 491 ,501 ,511 ,521 ,531 ,542 ,553 ,562 ,574 ,583 ,592 ,602 ,612 ,623 ,633 ,642	185	kg/ha
16/04/2019	f	Applied Nitro-Chalk (27% N) by hand; Plots 493 ,502 ,514 ,522 ,533 ,544 ,551 ,561 ,573 ,582 ,594 ,604 ,613 ,621 ,631 ,644	370	kg/ha
16/04/2019	f	Applied Nitro-Chalk (27% N) by hand; Plots 492 ,503 ,512 ,524 ,534 ,543 ,554 ,563 ,572 ,584 ,593 ,603 ,614 ,624 ,634 ,641	556	kg/ha
18/04/2019	f	Applied SOP (50% K2O, 45% SO3); Plots 492 ,503 ,512 ,524 ,534 ,543 ,554 ,563 ,572 ,584 ,593 ,603 ,614 ,624 ,634 ,641	150	kg/ha
18/04/2019	f	Applied Nitram (34.5% N); Plots 67, 68, 71, 72, 73, 74, 75, 76	290	kg/ha
29/04/2019	p	Sprayed Ally Max	42	g/ha
29/04/2019	p	Sprayed Hurler	500	ml/ha
29/04/2019	p	Sprayed Sprinter	2	lt/ha
29/04/2019	p	Sprayed Envoy	1	lt/ha
20/06/2019	p	Sprayed Sprinter	2	Lt/ha
20/06/2019	p	Sprayed Cello	1.25	Lt/ha
18/09/2019	a	Harvested all Plots; odds & ends cleared	-	-

W Oats

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14/11/2018	f	Applied TSP (46% P2O5); Plots 5, 6 ,9, 10, 45 to 48	127	kg/ha
16/11/2018	a	Drilled Mascani trt Beret Gold	350	seeds/m^2
18/04/2019	f	Applied SOP (50% K2O, 45% SO3); Plots 5, 6 ,9, 10, 45 to 48	150	kg/ha
18/04/2019	f	Applied Nitram (34.5% N); Plots 5, 6, 9, 10, 45 to 48	290	kg/ha
29/04/2019	p	Sprayed Ally Max	42	g/ha
29/04/2019	p	Sprayed Hurler	500	ml/ha
29/04/2019	p	Sprayed Sprinter	2	lt/ha
29/04/2019	p	Sprayed Envoy	1	lt/ha
20/06/2019	p	Sprayed Sprinter	2	Lt/ha
20/06/2019	p	Sprayed Cello	1.25	Lt/ha
18/09/2019	a	Harvested all Plots; odds & ends cleared	-	-

NOTE: Herbage and grain samples were taken for chemical analyses.

Yield Error Note: It was found that the FYM notation (dr) for some plots on Block 5 was incorrect in the 2019 field plan, and for several previous years (2003-2006, 2009). Consequently, the yield and plans for 2019 were corrected, but earlier yield books contain an error in some of the mean yields for FYM and NONE treatments.

LEYS

1ST CUT (02 JUL 2019) DRY MATTER TONNES/HECTARE

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

FYM_RES LEY	NONE	FYM	MEAN
LC1	1.58	2.15	1.87
LC2	2.10	2.51	2.30
LC3	2.35	2.47	2.41
LN1	1.54	1.76	1.65
LN2	7.64	6.17	6.91
LN3	5.80	5.34	5.57
(LLC/LC)LC1	1.48	1.78	1.63

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(LLC/LC)LC2	4.06	4.99	4.52
(LLC/LC)LC3	1.86	1.33	1.59
(LLN/LN)LN1	1.01	0.75	0.88
(LLN/LN)LN2	6.21	6.73	6.47
(LLN/LN)LN3	4.91	5.63	5.27
MEAN	3.38	3.47	3.42
1ST CUT MEAN DM%	31.4		

2ND CUT (06 NOV 2019) DRY MATTER TONNES/HECTARE

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

FYM_RES LEY	NONE	FYM	MEAN
LC1	1.83	1.60	1.71
LC2	0.13	0.07	0.10
LC3	-	-	-
LN1	0.80	1.12	0.96
LN2	0.58	0.40	0.49
LN3	-	-	-
(LLC/LC)LC1	1.46	1.31	1.38
(LLC/LC)LC2	0.12	0.18	0.15
(LLC/LC)LC3	-	-	-
(LLN/LN)LN1	0.81	1.50	1.15
(LLN/LN)LN2	0.25	0.51	0.38
(LLN/LN)LN3	-	-	-
MEAN	0.75	0.83	0.79
2ND CUT MEAN DM%	20.40		

Note: No 2nd Cut of the third year leys (LC3, LN3, LC3, (LLC/LC)LC3, (LLN/LN)LN3) was taken because they were cultivated before the 06/11/2019 (date of 2nd cut on first and second year leys).

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Total of 2 CUTS DRY MATTER TONNES/HECTARE

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

FYM_RES LEY	NONE	FYM	MEAN
LC1	3.41	3.75	3.58
LC2	2.22	2.58	2.40
LC3	-	-	-
LN1	2.34	2.88	2.61
LN2	8.22	6.56	7.39
LN3	-	-	-
(LLC/LC)LC1	2.94	3.09	3.01
(LLC/LC)LC2	4.17	5.16	4.67
(LLC/LC)LC3	-	-	-
(LLN/LN)LN1	1.82	2.25	2.03
(LLN/LN)LN2	6.45	7.24	6.85
(LLN/LN)LN3	-	-	-
MEAN	3.95	4.19	4.07
TOTAL OF 2 CUTS MEAN DM%	28.20		

Note: Since 2014 grass-only leys have not been receiving N after the first cut and in some years K has not been applied after the first cut on both grass-only and grass-clover leys.

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ARABLE TREATMENT CROPS

WINTER BEANS – No yields due to very poor establishment and growth

RYE (EXTRA)

GRAIN (85% DRY MATTER) TONNES/HECTARE

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

FYMRES ROTATION	NONE	FYM	Mean
(AO)R	4.22	3.88	4.05
(LLn/AO)R	5.28	4.11	4.70
(LLc/ABe)R	5.62	5.08	5.35
(ABe)R	4.57	4.36	4.46
Mean	4.92	4.36	4.64

Grain mean DM%	86.2
Plot area harvested	0.00393

WINTER WHEAT

Grain tonnes/hectare
***** *Tables of means* *****

FYMRES ROTATION	none	FYM	Mean
(AO)W	2.55	1.38	1.97
(ABe)W	2.11	2.42	2.26
(LLn/AO)W	3.92	3.12	3.52
(LLc/ABe)W	3.50	3.21	3.36
(LN)W	3.84	2.58	3.21
(LLN/Ln)W	4.39	4.02	4.20
(LC)W	3.22	4.73	3.98
(LLc/Lc)W	3.60	2.16	2.88
Mean	3.39	2.95	3.17

N ROTATION	0	80	160	240	Mean
(AO)W	0.90	2.40	2.04	2.52	1.97
(ABe)W	0.55	2.18	3.04	3.28	2.26

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(LLn/AO)W	1.35	4.22	4.83	3.66	3.52
(LLc/ABe)W	1.04	3.64	4.21	4.54	3.36
(LN)W	2.86	4.69	3.40	1.87	3.21
(LLN/Ln)W	2.97	4.24	4.66	4.94	4.20
(LC)W	2.22	4.39	4.55	4.75	3.98
(LLc/Lc)W	1.59	3.48	3.35	3.11	2.88
Mean	1.69	3.65	3.76	3.58	3.17

N	0	80	160	240	Mean
FYMRES					
none	1.71	3.77	4.06	4.02	3.39
FYM	1.66	3.54	3.46	3.15	2.95
Mean	1.69	3.65	3.76	3.58	3.17

N		0	80	160	240
ROTATION	FYMRES				
(AO)W	none	0.75	2.83	3.67	2.95
	FYM	1.05	1.97	0.41	2.10
(ABe)W	none	0.55	2.17	2.84	2.88
	FYM	0.55	2.18	3.23	3.69
(LLn/AO)W	none	1.51	4.42	4.60	5.14
	FYM	1.18	4.03	5.07	2.18
(LLc/ABe)W	none	0.97	3.53	4.85	4.64
	FYM	1.11	3.74	3.57	4.44
(LN)W	none	3.08	4.56	5.63	2.08
	FYM	2.65	4.82	1.18	1.65
(LLN/Ln)W	none	2.94	5.08	4.19	5.34
	FYM	3.00	3.41	5.14	4.53
(LC)W	none	1.40	3.99	3.43	4.04
	FYM	3.03	4.78	5.67	5.45
(LLc/Lc)W	none	2.45	3.56	3.30	5.10
	FYM	0.73	3.40	3.40	1.12
Mean		1.69	3.65	3.76	3.58

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Grain mean DM%	85.70
Plot area harvested	0.00183

WINTER RYE

Grain tonnes/hectare

Tables of means

FYMRES	none	FYM	Mean
ROTATION			
(AO)R	5.90	5.92	5.91
(ABe)R	5.08	4.95	5.02
(LLn/AO)R	6.56	6.84	6.70
(LLc/ABe)R	5.89	5.55	5.72
(Ln)R	6.48	5.95	6.22
(LLn/Ln)R	5.88	7.17	6.53
(Lc)R	6.97	7.45	7.21
(LLc/Lc)R	6.50	7.28	6.89
Mean	6.16	6.39	6.27

N	0	50	100	150	Mean
ROTATION					
(AO)R	3.49	5.45	7.17	7.54	5.91
(ABe)R	2.85	5.13	6.26	5.84	5.02
(LLn/AO)R	5.41	6.53	6.93	7.93	6.70
(LLc/ABe)R	3.84	5.52	6.86	6.65	5.72
(Ln)R	4.34	6.66	7.02	6.86	6.22
(LLn/Ln)R	5.49	7.37	7.03	6.22	6.53
(Lc)R	5.98	8.34	7.51	7.01	7.21
(LLc/Lc)R	6.03	6.87	8.23	6.41	6.89
Mean	4.68	6.49	7.13	6.81	6.27

N	0	50	100	150	Mean
FYMRES					
none	4.54	6.45	7.26	6.39	6.16

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FYM	4.82	6.52	6.99	7.23	6.39
Mean	4.68	6.49	7.13	6.81	6.27

	N	0	50	100	150
ROTATION	FYMRES				
(AO)R	none	3.51	5.45	7.46	7.19
	FYM	3.47	5.45	6.89	7.89
(ABe)R	none	2.83	5.20	6.85	5.43
	FYM	2.86	5.06	5.66	6.24
(LLn/AO)R	none	4.90	6.39	6.33	8.61
	FYM	5.92	6.67	7.54	7.25
(LLc/ABe)R	none	4.29	5.57	7.55	6.15
	FYM	3.39	5.48	6.16	7.16
(Ln)R	none	4.79	7.09	7.26	6.79
	FYM	3.89	6.22	6.78	6.92
(LLn/Ln)R	none	4.77	7.24	7.17	4.35
	FYM	6.20	7.51	6.88	8.10
(Lc)R	none	5.66	7.98	7.27	6.99
	FYM	6.31	8.71	7.76	7.02
(LLc/Lc)R	none	5.55	6.66	8.21	5.58
	FYM	6.51	7.09	8.26	7.25
	Mean	4.68	6.49	7.13	6.81

Grain mean DM%	85.50
Plot area harvested	0.00183

WINTER OATS

GRAIN (85% DRY MATTER) TONNES/HECTARE

Tables of means

FYMRES	NONE	FYM	Mean
ROTATION			
ABe	2.81	3.36	3.09
AO	1.22	0.99	1.10

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LLc/ABe	3.28	3.14	3.21
LLn/AO	0.82	1.08	0.95
Mean	2.03	2.14	2.09

Grain mean DM%	88.20
Plot area harvested	0.00393

Note: Grain and herbage samples were taken for chemical analyses and archiving.

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