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Yields of the Field Experiments 2014

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W/RN/3 Ley Arable

Rothamsted Research

Rothamsted Research (2015) *W/RN/3 Ley Arable ;* Yields Of The Field Experiments 2014, pp 37 - 47
- DOI: https://doi.org/10.23637/ERADOC-1-224

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14/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 77th year, leys, w. beans, w. wheat, w. rye

For previous years see 'Details' 1967 & 1973 and Yield Books for 74-13/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 2014 (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 2014 (see date below).

Continuous rotations	No FYM	FYM Res
Before wheat	Half plots	Half plots
Abe/Be	430	430
AO/O	350	260
LLn/AO	220	180
Ln/Ln	10	10
None to other plots.		

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Experimental Diary

Date		Application	Rate	Units
ALL				
07-Oct-13	f	Applied TSP - Arable plots	127	kg/ha
30-Oct-13	a	Ploughed		
30-Oct-13	a	Power harrowed		
14-Mar-14	a	Rolled - Rolled for wire worm		
01-Apr-14	p	Sprayed Sprinter - 147 l/ha water. Cereals only	1.5	l/ha
11-Apr-14	a	Cut paths		
15-Apr-14	f	Applied SOP - Applied to all arable plots	150	kg/ha
15-Apr-14	p	Sprayed Allay Max - 200 l/ha water.	40	g/ha
15-Apr-14	p	Sprayed Allay Hatchet Xtra - 200 l/ha water.	0.75	l/ha
15-Apr-14	p	Sprayed BASF 3C - 200 l/ha water.	2	l/ha
15-Apr-14	p	Sprayed Keystone - 200 l/ha water.	0.8	l/ha
30-Apr-14	p	Sprayed San 703 - 200 l/ha water volume	1.5	l/ha
30-Apr-14	p	Sprayed Hallmark with Zeon Technology - 200 l/ha water volume	75	ml/ha
11-Sep-14	p	Sprayed Firebrand - 200 l/ha water volume. Problem with "Auto control" on sprayer, switched to manual.	1	l/ha
11-Sep-14	p	Sprayed Samurai - 200 l/ha water volume. Problem with "Auto control" on sprayer, switched to manual.	4	l/ha
Grass ley and clover/grass leys (first year leys)				
07-Oct-13	f	Applied TSP - 1st year leys	213	kg/ha
25-Oct-13	f	Applied SOP - Applied to 1st year leys	140	kg/ha
29-Oct-13	f	Applied Nitram - Plots 77,78,79,80.	72.4	kg/ha
29-Oct-13	f	Applied Nitram - Plots 65,66,69,70	144.9	kg/ha
03-Nov-13	s	Drilled Grass and Clover plots - Grass and clover mix - Plots 77,78,79,80	30	kg/ha
03-Nov-13	s	Drilled Grass - Plots 69 and 70	30	kg/ha
13-Mar-14	p	Sprayed Samurai - plots 65 and 66 only, prep for grass plots.	4	l/ha
08-Apr-14	f	Applied Nitram Fertilizer - Grass only plots. Plots 65, 66, 69, 70	217	kg/ha
14-Apr-14	a	Springtyne - Plots 65 and 66 ready for drilling		
14-Apr-14	s	Drilled Grass plots 65 and 66	30	kg/ha
26-Jun-14	a	Cut grass plots for yield		
30-Jun-14	a	Mowed grass plots		
01-Jul-14	a	Turned hay		
02-Jul-14	a	Turned hay		
03-Jul-14	a	Baled and Removed hay		
03-Dec-14	a	Cut grass plots for yield		
10-Dec-14	a	Topped grass plots		
Grass ley and clover/grass leys (2nd and 3rd year leys)				
07-Oct-13	f	Applied TSP - 2,3 year leys	213	kg/ha
25-Oct-13	f	Applied SOP - Applied to 2nd & 3rd year leys	140	kg/ha
08-Apr-14	f	Applied Nitram Fertilizer - Grass only plots. Plots 11, 12, 13, 14, 37, 38, 43, 44	217	kg/ha

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15-Apr-14	f	Applied MOP - Applied to leys	167	kg/ha
26-Jun-14	a	Cut grass plots for yield		
30-Jun-14	a	Mowed grass plots		
01-Jul-14	a	Turned hay		
02-Jul-14	a	Turned hay		
03-Jul-14	a	Baled and Removed hay		
03-Dec-14	a	Cut grass plots for yield		
10-Dec-14	a	Topped grass plots		

W. Beans

03-Nov-13	s	Drilled Winter beans - var. Wizzard - Plots 1,2,15,16,35,36,39,40	30	seeds/m^2
15-Nov-13	p	Sprayed Nivana - Bean plots only	4	l/ha
15-Nov-13	p	Sprayed Dictate - Bean plots only	0.2	l/ha
15-Apr-14	p	Sprayed Laser - Beans only. 200 l/ha water	1	l/ha
15-Apr-14	p	Sprayed Zarado - Beans only. 200 l/ha water	1	l/ha
02-Jun-14	p	Sprayed San 703 - Beans only. 200 l/ha water vloume.	2	l/ha
03-Sep-14	a	Cut plots for yield		
06-Sep-14	a	Baled and Removed		

W. Wheat

29-Oct-13	f	Applied MOP - Corrective K applied to plots 17,18,19,20,21,22,27,28,31,32.		
31-Oct-13	s	Drilled var. Solstice tr Redigo Deter - Plots 17-32	400	seeds/m^2
14-Apr-14	f	Applied first split N as Nitram – Test plots only.	148	kg/ha
30-Apr-14	p	Sprayed Atlantis - wheat plots only. 200 l/ha water.	0.4	kg/ha
30-Apr-14	p	Sprayed Sekator - wheat plots only. 200 l/ha water.	0.2	kg/ha
30-Apr-14	p	Sprayed Cortez - wheat plots only. 200 l/ha water.	0.5	l/ha
30-Apr-14	p	Sprayed Biopower - wheat plots only. 200 l/ha water.	1	l/ha
02-May-14	f	Applied N treatment - as "main N". Test Plots 174,183,193,201,212,221,231,242,252,262,274,282,292,304,311,323	148	kg/ha
02-May-14	f	Applied N treatment - as "main N". Test Plots 171,182,194,204,214,223,234,241,251,263,272,283,294,303,314,321	444	kg/ha
02-May-14	f	Applied N treatment - as "main N". Test Plots 172,184,191,202,211,222,232,242,254,261,273,281,291,301,313,324	741	kg/ha
21-May-14	p	Sprayed Refine Max - Winter Wheat only. 150 l/ha water volume.	75	g/ha
21-May-14	p	Sprayed Refine Kingdom - Winter Wheat only. 150 l/ha water volume.	1.25	l/ha
21-May-14	p	Sprayed Refine Bravo 500 - Winter Wheat only. 150 l/ha water volume.	1	l/ha
21-May-14	p	Sprayed Refine Hatchet Xtra - Winter Wheat only. 150 l/ha water volume.	0.75	l/ha
06-Jun-14	p	Sprayed Cello - 150 l/ha water volume. Wheat only	0.55	l/ha
06-Jun-14	p	Sprayed Amistar - 150 l/ha water volume. Wheat only	0.25	l/ha
06-Jun-14	p	Sprayed Hallmark - 150 l/ha water volume. Wheat only	40	ml/ha
03-Sep-14	a	Cut plots for yield		
06-Sep-14	a	Baled and Removed		

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W. Rye

18-Oct-13	a	Applied Chalk - Applied to block 4.	5	t/ha
01-Nov-13	s	Drilled Rye - var. Kapitan - Plots 49 to 63, 67,68,71,72,73 to 76	400	seeds/m^2
08-Apr-14	f	Applied Nitram Fertilizer - Rye treatment plots. 67,68,71,72,73,74,75,76	290	kg/ha
06-May-14	f	Applied Nitrochalk by hand - Applied to Rye test crop. Plots 494,504,513,523,532,541,552,564,571,581,591,601,611,622,632,643	185	kg/ha
07-May-14	f	Applied Nitrochalk by hand - Applied to Rye test crop. Plots 491,501,511,521,531,542,553,562,574,583,592,602,612,623,633,642	370	kg/ha
08-May-14	f	Applied Nitrochalk by hand - Applied to Rye test crop. Plots 493,502,514,522,533,544,551,561,573,582,594,604,613,621,631,644	556	kg/ha
21-May-14	p	Sprayed Covershield - Rye plots only. 200 l/ha water volume	0.8	l/ha
13-Jun-14	p	Sprayed Fezan - Rye only.	0.75	l/ha
03-Sep-14	a	Cut plots for yield		
06-Sep-14	a	Baled and Removed		

W. Oats

01-Nov-13	s	Drilled Oats var. Gerald trt Redigo - Plots 5,6,9,10,45 to 48; Half of plots 65 and 66 were drilled with oats by accident too. These will be removed in the spring.	400	seeds/m^2
05-Mar-14	p	Sprayed Absolute with Zeon Tec. - Oats only	0.12	l/ha
05-Mar-14	p	Sprayed Hallmark with Zeon Tec. - Oats only	50	ml/ha
08-Apr-14	f	Applied Nitram Fertilizer - Oats - Plots 5, 6, 9, 10, 45 to 48	290	kg/ha
21-May-14	p	Sprayed Simba - Winter Oats. 200 l/ha water volume.	30	l/ha
21-May-14	p	Sprayed Cello - Winter Oats. 200 l/ha water volume.	0.6	l/ha
09-Jun-14	p	Sprayed Cello - Oats only. 150 l/ha water volume.	0.55	l/ha
09-Jun-14	p	Sprayed Hallmark - Oats only. 150 l/ha water volume.	40	ml/ha
03-Sep-14	a	Cut plots for yield		
06-Sep-14	a	Baled and Removed		

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

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14/W/RN/3

LEYS

1ST CUT (26/6-14) DRY MATTER TONNES/HECTARE

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

FYM_RES LEY	NONE	FYM	MEAN
LC1	2.14	2.27	2.21
LC2	4.98	4.89	4.93
LC3	5.25	4.54	4.89
LN1	1.46	1.79	1.62
LN2	7.83	8.48	8.16
LN3	6.47	6.39	6.43
(LLC/LC) LC1	2.81	2.19	2.50
(LLC/LC) LC2	4.82	4.78	4.80
(LLC/LC) LC3	5.15	5.45	5.30
(LLN/LN) LN1	4.54	4.16	4.35
(LLN/LN) LN2	6.85	6.15	6.50
(LLN/LN) LN3	7.08	7.01	7.04
MEAN	4.95	4.84	4.89

1ST CUT MEAN DM% 27.6

2ND CUT (3-Dec-14) DRY MATTER TONNES/HECTARE

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

FYM_RES LEY	NONE	FYM	MEAN
LC1	0.32	0.47	0.40
LC2	0.32	0.40	0.36
LC3	0.00	0.00	0.00
LN1	0.60	0.52	0.56
LN2	0.61	0.33	0.47
LN3	0.00	0.00	0.00
(LLC/LC) LC1	0.27	0.44	0.35
(LLC/LC) LC2	0.86	1.05	0.96
(LLC/LC) LC3	0.00	0.00	0.00
(LLN/LN) LN1	0.42	0.88	0.65
(LLN/LN) LN2	0.52	0.92	0.72
(LLN/LN) LN3	0.00	0.00	0.00
MEAN	0.33	0.42	0.37

2ND CUT MEAN DM% 31.8

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14/W/RN/3

TOTAL OF 2 CUTS DRY MATTER TONNES/HECTARE

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

FYM_RES LEY	NONE	FYM	MEAN
LC1	2.46	2.75	2.60
LC2	5.30	5.28	5.29
LC3	5.25	4.54	4.89
LN1	2.07	2.31	2.19
LN2	8.44	8.80	8.62
LN3	6.47	6.39	6.43
(LLC/LC)LC1	3.08	2.63	2.85
(LLC/LC)LC2	5.68	5.83	5.76
(LLC/LC)LC3	5.15	5.45	5.30
(LLN/LN)LN1	4.96	5.04	5.00
(LLN/LN)LN2	7.38	7.07	7.22
(LLN/LN)LN3	7.08	7.01	7.04
MEAN	5.28	5.26	5.27

TOTAL OF 2 CUTS MEAN DM% 29.1

ARABLE TREATMENT CROPS

BEANS

GRAIN (85% DRY MATTER) TONNES/HECTARE

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

FYMRES ROTATION	NONE	FYM	Mean
(AO)Be	1.81	2.16	1.98
(LLn/AO)Be	3.10	2.93	3.02
(LLc/ABe)Be	1.49	0.91	1.20
(ABe)Be	0.48	0.49	0.48
Mean	1.72	1.62	1.67

GRAIN MEAN DM% 83.9

PLOT AREA HARVESTED 0.00413

Note: In May 2014 the beans were accidentally sprayed with herbicide. Consequently, the above yields should not be used for future analysis.

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14/W/RN/3

OATS

GRAIN (85% DRY MATTER) TONNES/HECTARE

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

FYMRES ROTATION	NONE	FYM	Mean
ABe	5.61	6.03	5.82
AO	5.31	5.48	5.39
LLc/ABe	6.44	6.11	6.27
LLn/AO	4.78	5.04	4.91
Mean	5.53	5.66	5.60

GRAIN MEAN DM% 85.7

PLOT AREA HARVESTED 0.00413

RYE

GRAIN (85% DRY MATTER) TONNES/HECTARE

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

FYMRES ROTATION	NONE	FYM	Mean
(ABe)R	5.34	4.80	5.07
(AO)R	4.66	4.42	4.54
(LLn/AO)R	5.36	4.81	5.08
(LLc/ABe)R	8.13	5.54	6.83
Mean	5.87	4.89	5.38

GRAIN MEAN DM% 83.6

PLOT AREA HARVESTED 0.00413

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14/W/RN/3

W. WHEAT

Grain tonnes/hectare

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

FYMRES ROTATION	none	FYM	Mean
(AO)W	5.71	4.77	5.24
(ABe)W	4.41	5.19	4.80
(LLn/AO)W	7.06	6.65	6.86
(LLc/ABe)W	5.02	4.64	4.83
(LN)W	6.01	5.89	5.95
(LLN/Ln)W	6.48	5.23	5.85
(LC)W	5.18	5.31	5.24
(LLc/Lc)W	7.09	6.33	6.71
Mean	5.87	5.50	5.69

N ROTATION	0	80	160	240	Mean
(AO)W	0.86	5.44	7.51	7.15	5.24
(ABe)W	0.50	4.49	6.62	7.60	4.80
(LLn/AO)W	1.54	6.11	9.66	10.12	6.86
(LLc/ABe)W	0.59	4.90	6.07	7.76	4.83
(LN)W	2.25	5.71	8.49	7.35	5.95
(LLN/Ln)W	1.66	6.40	7.17	8.19	5.85
(LC)W	1.96	4.90	6.57	7.54	5.24
(LLc/Lc)W	1.73	6.82	9.03	9.24	6.71
Mean	1.39	5.60	7.64	8.12	5.69

N FYMRES	0	80	160	240	Mean
none	1.37	6.01	7.61	8.49	5.87
FYM	1.40	5.19	7.67	7.75	5.50
Mean	1.39	5.60	7.64	8.12	5.69

N ROTATION	FYMRES	0	80	160	240
(AO)W	none	0.78	5.64	7.87	8.56
	FYM	0.95	5.24	7.15	5.75
(ABe)W	none	0.33	4.11	6.19	7.01
	FYM	0.66	4.87	7.04	8.18
(LLn/AO)W	none	1.47	6.92	10.05	9.81
	FYM	1.60	5.30	9.28	10.42
(LLc/ABe)W	none	0.66	5.02	5.95	8.46
	FYM	0.53	4.78	6.20	7.05
(LN)W	none	2.52	6.34	7.55	7.62
	FYM	1.97	5.09	9.42	7.09
(LLN/Ln)W	none	1.79	6.96	8.29	8.87
	FYM	1.53	5.84	6.04	7.52
(LC)W	none	1.48	5.32	6.69	7.23
	FYM	2.45	4.48	6.45	7.85
(LLc/Lc)W	none	1.94	7.77	8.32	10.32
	FYM	1.52	5.88	9.74	8.16

Grain mean DM% 83.9
Plot area harvested 0.00192

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14/W/RN/3

W. RYE

Grain tonnes/hectare

FYMRES	none	FYM	Mean
ROTATION			
(AO)R	2.95	3.14	3.05
(ABe)R	3.57	3.45	3.51
(LLn/AO)R	3.73	3.65	3.69
(LLc/ABe)R	3.60	3.85	3.73
(Ln)R	3.91	4.19	4.05
(LLn/Ln)R	4.25	4.25	4.25
(Lc)R	3.81	4.11	3.96
(LLc/Lc)R	4.64	4.09	4.37
Mean	3.81	3.84	3.82

N	0	50	100	150	Mean
ROTATION					
(AO)R	1.99	3.27	3.64	3.28	3.05
(ABe)R	1.98	3.56	4.29	4.20	3.51
(LLn/AO)R	2.43	4.04	4.53	3.76	3.69
(LLc/ABe)R	2.15	3.69	4.52	4.54	3.73
(Ln)R	2.65	4.10	4.76	4.69	4.05
(LLn/Ln)R	2.87	4.37	4.85	4.90	4.25
(Lc)R	2.85	4.24	4.73	4.04	3.96
(LLc/Lc)R	3.77	3.67	4.82	5.20	4.37
Mean	2.59	3.87	4.52	4.33	3.82

N	0	50	100	150	Mean
FYMRES					
none	2.73	3.87	4.44	4.18	3.81
FYM	2.44	3.86	4.60	4.47	3.84
Mean	2.59	3.87	4.52	4.33	3.82

N	0	50	100	150
ROTATION FYMRES				
(AO)R none	1.88	3.30	3.62	3.01
FYM	2.11	3.25	3.66	3.56
(ABe)R none	1.92	3.53	4.34	4.48
FYM	2.04	3.59	4.24	3.92
(LLn/AO)R none	2.64	4.07	4.45	3.74
FYM	2.21	4.00	4.61	3.77
(LLc/ABe)R none	2.12	3.66	4.42	4.19
FYM	2.17	3.71	4.63	4.90
(Ln)R none	2.69	4.10	4.66	4.18
FYM	2.60	4.11	4.85	5.20
(LLn/Ln)R none	2.92	4.35	4.72	5.00
FYM	2.83	4.39	4.99	4.81
(Lc)R none	2.96	4.14	4.44	3.72
FYM	2.73	4.34	5.02	4.36
(LLc/Lc)R none	4.72	3.84	4.86	5.16
FYM	2.83	3.49	4.79	5.25

Grain mean DM% 83.4

Plot area harvested 0.00192

https://doi.org/10.23637/ERADOC-1-224