ROTHAMSTED
RESEARCH

Results of the

Classical and other

Long-term Experiments

2017

Results of the Classical and other Long-term Experiments 2017

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Conventions

For each experiment the current treatments are shown with the factor and level names which are used in the tables.

For each experiment references are given to previous years. These refer to the '(Numerical) (Results)' previous editions of 'Yields of the Field Experiments'.

For the classical and some long-term experiments reference is made to 'Details' – separate publications, giving full descriptions of treatments until 1977 & 1973, with full titles 'Details of the Classical and Long Term Experiments up to 1977' and 'Details of the Classical and Long Term Experiments up to 1973'.

The following conventions are observed unless otherwise stated.

All areas are in hectares. All plot dimensions are in metres.

All rates of application of fertilizers, sprays etc. are per hectare.

All yields are per hectare.

For any other crop, details of abbreviations are given as necessary

FERTILIZERS

27%N or 34.5% N means nitrogen as calcium ammonium nitrate or ammonium nitrate.

Anhydrous Sulphate of Soda	
Chalk	
Compost	
Double Top	27% nitrogen and 30% SO_3
FYM	Farmyard manure (from bullocks)
Headland Manganese 500	500 g/l 27.5% w/w manganese carbonate
Kieserite	$MgSO_4H_2O$ 17.7% magnesium and 23.3% sulphur
Maize Tops	
Manganese sulphate	$Mn_2 (SO_4)_3$ 27% manganese and 24% sulphur
Magnesium sulphate	$MgSO_4$ H_2O 17.7% magnesium and 23.3% sulphur
Muriate of potash (MOP)	60% K_2O as Potassium Chloride (KCl)
Nitram	34.5% N
Nitraprill	34.5% N
Nitrate of soda	$NaNO_3$ 16% nitrogen and 27% sodium

Nitro-Chalk	Calcium Ammonium Nitrate 27% N
Silicate of soda	Na_2SiO_3 37% sodium and 23% silica
Sodium Sulphate	35% Sodium
Sulphate of ammonia	$(NH_4)_2SO_4$ 21% nitrogen 24% sulphur
Sulphate of potash (SOP)	K_2SO_4 50% K_2O and 18.4% sulphur
Triple superphosphate (TSP)	47% P_2O_5

Cereal straw is removed unless otherwise stated.

GS: Growth Stage.
tm): Tank mix; two or more products applied together.
tr: means seed dressing

PESTICIDES USED

The following list of pesticides is based on The UK Pesticides Guide, CAB International and The British Crop Protection Council. CABI Publishing

KEY TO ABBREVIATIONS

ad	Adjuvant	d	Desiccant	f	Fungicide
gr	Growth regulator	h	Herbicide	i	Insecticide
m	Molluscicide	n	Nematicide	tr	Trace elements

Trade Name	Function	Active ingredient
Atlantis	h	iodosulfuron-methyl-sodium + mesosulfuron-methyl (0.6:3.0 % w/w)
Aviator 235 Xpro	f	bixafen + prothioconazole (75:160g/l)
Balear 720	f	chlorothalonil (720 g/l)
BASF 3C	gr	chlormequat (750 g/l)
Beret Gold	f	fludioxonil (25 g/l), seed dressing.
BioPower	ad	6.7% w/w 3,6-dioxaeicosylsulphate sodium salt and 20.2% w/w 3,6-dioxaoctadecylsulphate sodium salt
Bravo 500	f	chlorothalonil (500 g/l)
Buffalo Elite	ad	ammonium sulphate (40 % w/w), water conditioner.
Callisto	h	mesotrione (100 g/l)

Cello	f	prothioconazole + spiroxamine + tebuconazole (100:250:100 g/l)
Chex	ad	A soluble liquid concentrate containing water conditioning and acidifying agents, humectant, pH buffer and an anti-foam. Water conditioner.
Claw 500	f	chlorothalonil (500 g/l)
Cogent (Intracrop)	ad	32.67% w/w alkoxylated alcohols and 1.0% w/w trisiloxane organosilicone copolymers
Cortez	f	epoxiconazole (125 g/l)
Cyflamid	f	cyflufenamid (50 g/l)
Defy	h	prosulfocarb (800 g/l)
Deploy 1000	ad	alcohol alkoxylate (1000 g/l). Non-ionic spreader.
Deter	i	clothianidin (250 g/l)
Envoy	f	epoxiconazole + pyraclostrobin (62.5:85 g/l)
Epic	f	epoxiconazole (125 g/l)
Excalibur	h	diflufenican + flupyrsulfuron-methyl (44.4:5.6 % w/w)
Eximus	h	pendimethalin (400 g/l)
Fezan	f	tebuconazole (250g/l)
Firebrand	ad	ammonium sulphate (500 g/l)
Hallmark with zeon tech	i	lambda-cyhalothrin (100 g/l)
Hatchet xtra	h	fluroxypyr (200 g/l)
Hurler	h	fluroxypyr (200 g/l)
Keystone	f	epoxiconazole + isopyrazam (99:125 g/l)
Kingdom	f	boscalid + epoxiconazole (140:50 g/l)
Kinto	f	prochloraz + triticonazole (60:20 g/l), seed dressing.
Mesurol	i	methiocarb (500g/l), seed dressing.
Moddus	gr	trinexapac-ethyl (250 g/l)
Nirvana	h	imazamox + pendimethalin (16.7:250 g/l)
Palio	h	florasulam + pyroxsulam (1.4:7.1 % w/w)
Raxil star	f	fluopyram + prothioconazole + tebuconazole (20.8:103.1:63.2 g/l), seed dressing.

Redigo Pro	f	prothioconazole + tebuconazole (15:20 g/l), seed dressing.
Refine Max	h	metsulfuron-methyl + thifensulfuron-methyl (6.7:33.3 w/w)
Samson Extra	i	nicosulfuron (60 g/l)
Samurai	h	glyphosate (360 g/l)
Simba SX	h	metsulfuron-methyl (20 % w/w)
Stabilan	gr	chlormequat (750 g/l)
TDS Major	m	metaldehyde (4% w/w)
Troy 480	h	bentazone (480 g/l)
Vortex	f	epoxiconazole + fluxapyroxad + pyraclostrobin (41.6:41.6:61 g/l)
Sprinter-K	foliar feed	K_20, 30% w/w (44,4% w/v)
San 703	f	chlorothalonil + cyproconazole (375:40 g/l)
3C Chlormequat	gr	chlormequat (750 g/l)

Machinery Referred to in the Diary Notes

Cultivators	**Manufacturer**	**Width**	**Description**
Plough	Kverneland	1.5 m	5 Furrow, 25 cm Furrows.
Cultipress	Simba	3.3 m	Used after Ploughing.
Flexitine	Bunford	3.3 m	Used for lifting Worked ground.
Powerharrow	Kverneland	3.0 m	Used for creating seed bed.
Rotavator	Howard	1.3 m	Mainly used for BK/1 Paths.
Rotavator	Concept	1.2 m	Mainly Used for HB/2 Paths.

Drills	**Manufacturer**	**Width**	**Description**
Accord Combination Drill	Kverneland	3.0 m	Power-harrow Mounted Pneumatic drill with Suffolk coulters 12.5 cm apart.
Maize Drill	Nodet Pneumasem 2	5 Rows	Rows spaced at 70 cm.

Chemical Applications	**Manufacturer**	**Width**	**Description**
Aero-spreader	Kuhn	12 m	Tractor Mounted - General Fert Applications.

Muck Spreader	International	1.5 m	Trailed - FYM Applications.
Exacto-matic	Ransome, Nordsten	3.8 m	Tractor Mounted - Fert Applications.
Sprayer	Knight	24 m	Tractor Mounted - Chemical Application.
Quickpass	Yr-Crop	1.5 m	Trailed - Fert Applicationsp.
Lowspread	Lowspread	2.76 m	Tractor Mounted - Fert Applications.

Harvesters	**Manufacturer**	**Width**	**Description**
Rosenlew SR2010	Sampo	(Cut) 2m	Cereal Combine Harvester with a Continuous Weighing System.
3760	John Deere	2 Row	Maize Harvester, Cut and Mulch. Trailed Machine used after plot yields.
Tucano	Claas	6 m	Commercial Combine used for harvesting discards after plot yields.
Box Mower	Wilder	1.1 m	Box Mower Mainly used for yields on PG/5.
Mower	Unifarm	1.83 m	Commercial Mower used to mow discards on PG/5.
Plot Combine	Haldrup	(Cut) 2m	Cereal Combine Harvester (used 2017 Onward).

Other	**Manufacturer**	**Width**	**Description**
Ring Rolls	Cousins	3.3 m	Ring rolls for covering seed post drilling.
Topper 9	McConnell	2.72 m	Topper used for topping stubbles and grass areas.
Small Topper	Kilworth	1.1 m	Topper used with Iseki Tractor - Used for cutting Paths.
945 Conventional Baler	New Holland	-	Traditional Baler Used for baling straw samples.
Round Baler	Claas	-	Used for clearing unwanted leftover straw/grass from experiments.

Tractors	**Manufacturer**	**Weight**	**Description**
T7210	New Holland	8.1 t	Main cultivations tractor.
TL6030 Elite	New Holland	5.5 t	Sprayer tractor.
6830	John Deere	5.6 t	Drill and fertiliser application tractor.
TH4335	Iseki	1.1 t	Paths cutting tractor.

T503	Tym	2.0 t	Fertiliser applications and Rotovating.

Application code: This is used to identify the kind of application

a = application (cultivations, harvest, etc.), p = pesticide, f = fertilizer and s = seed.

17/R/BK/1 BROADBALK

Object: To study the effects of organic manures and inorganic fertilisers on continuous winter wheat and wheat in rotation. From 1968 two three-year rotations were included: potatoes, beans, winter wheat and fallow, winter wheat, winter wheat. In 1979 the first rotation was changed to fallow, potatoes, winter wheat. In 1980 the second rotation reverted to continuous winter wheat. Since 1985 part of the second rotation was added to the first to extend the rotation to fallow, potatoes, winter wheat, winter wheat, winter wheat. In 1996 the fallow was replaced by winter oats and potatoes replaced by maize in 1997.
The 175th year, winter wheat, winter oats and forage maize.
For previous years see 'Details' 1967 and 1973, Station Report for 1966, pp. 229-231; Station Report for 1968, Part 2; Station Report for 1982, Part 2, pp 5-44 and Yield Books for 74-16/R/BK/1.

Areas harvested [a]:

Wheat:	Section	
	0	0.00305
	1	0.00561
	4,8,7 and 6	0.00463
	9	0.00488
Oats:	2	0.00463
Maize:	3	0.00189

[a] The new Haldrup combine has a slightly smaller cut width (2.0m) than the previous Sampo combine (2.1m). Consequently, from 2017 cereal yields were based on a 2.0m cut width. Maize yields are calculated using a row spacing of 0.7m. Maize yields for 2009-2016 were recalculated to account for the increase in row width from 0.6m to 0.7m in 2009. The corrected yields are given in the 2016 yield book.

Treatments:
In 2001 some of the treatments were changed. The treatments are now:
Whole plots

PLOT	Fertilizers and organic manures Treatments	
	Plot	From 2001
01 (FYM)N4	01	N4
21FYMN3	2.1	FYM N2 (1)
22FYM	2.2	FYM
03Nil	03	None
05(P)KMg	05	(P) K Mg
06N1 (P) KMg	06	N1 (P) K Mg
07N2(P)KMg	07	N2 (P) K Mg
08N3(P)KMg	08	N3 (P) K Mg
09N4(P)KMg	09	N4 (P) K Mg
10N4	10	N4
11N4PMg	11	N4 P Mg
12N1+3+1(P)K2Mg2	12	N1+3+1 (P) K2 Mg2 (2)
13N4PK	13	N4 P K
14N4PK*(Mg*)	14	N4 P K* (Mg*)
15N5(P)KMg	15	N5 (P) K Mg

16N6(P)KMg	16	N6 (P) K Mg
17N1+4+1PKMg	17	N1+4+1 P K Mg
18N1+2+1PKMg	18	N1+2+1 P K Mg
19N1+1+1KMg	19	N1+1+1 K Mg
20N4KMg	20	N4 K Mg

(1) FYM N3 since 2005
(2) N1+3+1 (P) KMg since 2006

Winter oats; Nitrogen and farmyard manure were not applied.

N1, N2, N3, N4, N5, N6: 48, 96, 144, 192, 240, 288 kg N as 33.5% N; to be applied at the same time as the second dressings in the split nitrogen plots for wheat and to the seedbed for forage maize.

Split N to wheat

N1+1+1, 1+2+1 etc: Rates as above. Timings: first two weeks of March, GS31 or mid-April (whichever comes first) and GS37/mid-May.

Split N to forage maize

N2+1, 2+2, 2+3,2+4: Rates as above. Timings: to the seedbed and post-emergence.
P: 35 kg P as triple superphosphate
(P): (none since 2001), to be reviewed in 2018/19.
K: 90 kg K as potassium sulphate.
K2: 180 kg K as potassium sulphate (plus 450 kg K autumn 2000 only)
K*: 90 kg K as potassium chloride
Mg: 12 kg Mg as kieserite.
Mg2: 24 kg Mg as kieserite (plus 60kg Mg, autumn 2000 only).
(Mg*): (none since 2001), to be reviewed in 2018/19
FYM: Farmyard manure at 35 t

Previous treatment:
Whole plots

PLOT

Fertilizers and organic manures:-

	Plot	Treatments until 1967	Treatments from 1968	Treatments from 1985 – 2000
01DN4PK	01	-	D N2 P K	D N4 P K
21DN2	21	D	D N2	D N2
22D	22	D	D	D
030	03	None	None	None
05F	05	P K Na Mg	P K (Na) Mg	PK Mg
06N1F	06	N1 P K Na Mg	N1 P K (Na) Mg	N1 P K Mg
07N2F	07	N2 P K Na Mg	N2 P K (Na) Mg	N2 P K Mg
08N3F	08	N3 P K Na Mg	N3 P K (Na) Mg	N3 P K Mg
09N4F	09	N*1 P K Na Mg	N4 P K (Na) Mg	N4 P K Mg
10N2	10	N2	N2	N2
11N2P	11	N2 P	N2 P	N2 P
12N2PNA	12	N2 P Na	N2 P Na	N2 P Na
13N2PK	13	N2 P K	N2 P K	N2 P K

14N2PKMG	14	N2 P Mg	N2 P K Mg	N2 P K Mg
15N5F	15	N2 P K Na Mg	N3 P K(Na) Mg	N5 P K Mg
16N6F	16	N*2 P K Na Mg	N2 P K (Na) Mg	N6 P K Mg
17N1+3FH	17	N2 (A)	N2 ½[P K (Na) Mg]	N1+3 ½[P K Mg] (A)+
18N0+3FH	18	P K Na Mg (A)	N2 ½[P K (Na) Mg]	N0+3 ½[P K Mg] (A)+
19(C)	19	C	C	(C) (since 1989)
20N2KMG	20	N2 K Na Mg	N2 K (Na) Mg	N2 K Mg

(A) Alternating each year
+ This change since 1980. Treatments shown are those to winter wheat; autumn N alternates. Maize received N3 ½[PK Mg] on both plots 17 and 18. These treatments shown incorrectly in 1999-2002 Yield books.
Winter oats; Nitrogen and dung were not applied.

N1, N2, N3, N4, N5, N6:	48, 96, 144, 192, 240, 288 kg N as sulphate of ammonia until 1967, except N* which was nitrate of soda. All as 'Nitro-Chalk' in spring from 1968 to 1985, as 34.5% N since 1986.
N0+3; N1+3:	None in autumn + 144 kg N in spring; 48 kg N in autumn + 144 kg N in spring.
P:	35 kg P as triple superphosphate in 1974 and since 1988, single superphosphate in other years
K:	90 kg K as sulphate of potash
Na:	55 kg Na as sulphate of soda
(Na):	16 kg Na as sulphate of soda until 1973
Mg:	30kg Mg annually to Plot 14 (applied at 26 kg 1990 to 2000), 35 kg Mg every third year to other plots since 1974 (applied at 30 kg in 1991, 1994, 1997 and 2000 and at 15 kg on half rate treatments). All as kieserite since 1974, previously as sulphate of magnesia annually.
D:	Farmyard manure at 35 t
(C):	Castor meal to supply 96 kg N until 1988, none since
F:	Full rate P K (Na) Mg as above
H:	Half rate of above.

Strips of sub-plots: Until 1967 wheat alone was grown on the experiment, with some bare fallowing. From 1968, the experiment was divided into 10 sections with the following cropping:

SECTION

Section	1	9	0*	8+	6**	5	3	7	4	2
Year										
1968	W	W	W	W	F	W	W	P	W	BE
1969	W	W	W	W	W	F	W	BE	P	W
1970	W	W	W	W	W	W	F	W	BE	P
1971	W	W	W	W	F	W	W	P	W	BE
1972	W	W	W	F	W	F	W	BE	P	W
1973	W	W	W	W	W	W	F	W	BE	P
1974	W	W	W	W	F	W	W	P	W	BE
1975	W	W	W	W	W	F	W	BE	P	W
1976	W	W	W	W	W	W	F	W	BE	P

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Section	1	9	0*	8+	6**	5	3	7	4	2
Year										
1977	W	W	W	W	F	W	W	P	W	BE
1978	W	W	W	W	W	F	W	BE	P	W
1979	W	W	W	W	W	W	F	W	P	F
1980	W	W	W	W	W	W	W	F	W	P
1981	W	W	W	F	W	W	W	P	F	W
1982	W	W	W	W	W	W	W	W	P	F
1983	W	W	W	W	W	W	W	F	W	P
1984	W	W	W	W	W	W	W	P	F	W
1985	W	W	W	W	W	F	W	W	P	W
1986	W	W	W	W	W	P	F	W	W	W
1987	W	W	W	W	W	W	P	W	W	F
1988	W	W	W	F	W	W	W	F	W	P
1989	W	W	W	W	W	W	W	P	F	W
1990	W	W	W	W	W	F	W	W	P	W
1991	W	W	W	W	W	P	F	W	W	W
1992	W	W	W	W	W	W	P	W	W	F
1993	W	W	W	W	W	W	W	F	W	P
1994	W	W	W	F	W	W	W	P	F	W
1995	W	W	W	W	W	F	W	W	P	W
1996	W	W	W	W	W	P	O	W	W	W
1997	W	W	W	W	W	W	M	W	W	O
1998	W	W	W	W	W	W	W	O	W	M
1999	W	W	W	W	W	W	W	M	O	W
2000	W	W	W	W	W	O	W	W	M	W
2001	W	W	W	F	W	M	O	W	W	W
2002	W	W	W	W	W	W	M	W	W	O
2003	W	W	F	W	W	W	W	O	W	M
2004	W	W	F	W	W	W	W	M	O	W
2005	W	W	W	W	W	O	W	W	M	W
2006	W	W	W	W	W	M	O	W	W	W
2007	W	W	W	W	W	W	M	W	W	O
2008	W	W	W	F	W	W	W	O	W	M
2009	W	W	W	W	W	W	W	M	O	W
2010	W	W	W	W	W	O	W	W	M	W
2011	W	W	W	W	W	M	O	W	W	W
2012	W	W	W	W	W	W	M	W	W	O
2013	W	W	W	W	W	W	W	O	W	M
2014	W	W	W	W	W	W	W	M	O	W
2015[++]	W	W	W	F	W	O	W	W	M	W
2016	W	W	W	F	W	M	O	W	W	W
2017	W	W	W	W	W	W	M	W	W	O

W = winter wheat, O = winter oats (spring oats 2001), P = potatoes, BE = spring beans, F = fallow, M = forage maize

* Straw incorporated since autumn 1986. ** No sprays except weedkillers since 1985.

+ No weedkillers.

[++] Spring Wheat in 2015

NOTES:

(1) For a fuller record of treatments see 'Details' etc.

(2) From autumn 1975 to autumn 1986, chalk was applied at 2.9t each autumn to all plots in sets of Sections on a three-year cycle. Year 1: Sections 1, 2, 3. Year 2: Sections 6, 7, 8, 9. Year 3: Sections 0, 4, 5. From autumn 1988 until autumn 1992 a five-year cycle was used. Year 1: Sections 1, 3. Year 2: Sections 2, 8. Year 3: Sections 7, 9. Year 4: Sections 4, 6. Year 5: Sections 0, 5 (omitted). No chalk was applied after autumn 1991 until autumn 2007 when differential amounts were applied to selected plots (see "Results 2008"). Chalk was applied again to selected plots in autumn 2013, see 14/R/BK/1 diary information.

(3) In 2003 and 2004 section 0 was used for an experiment (CS/595) investigating different herbicides to control *Equisetum arvense*.

(4) In 2013 the wheat variety changed from Hereward to Crusoe, but it was sown very late (22nd February 2013) because of the very wet autumn and winter of 2012-13.

(5) Spring wheat (var Mulika) and winter oats (var Gerald) were sown in March 2015, instead of in autumn/winter 2014, because the very wet soil conditions in autumn 2014 prevented sowing of a winter crop. The whole site was spring-tine cultivated in March 2015 instead of being ploughed. Section 8 was left in bare fallow in 2015 & 2016 and had two in-season cultivations (inversion ploughing) each year to control weeds.

17/R/BK/1 Experimental Diary:

Date		Application	Rate	Units
All Sections				
20/09/2016	a	Batwing Topped	-	-
26/09/2016	f	Applied TSP - to strips 18, 17, 14, 13 + 11	171	kg/ha
26/09/2016	f	Applied MOP - to strip 14	181	kg/ha
27/09/2016	a	Started Ploughing - Thrown South	-	-
06/10/2016	a	Cultipressed All Ground	-	-
10/10/2016	a	Ring Rolled all field	-	-
12/10/2016	a	Ring Rolled	-	-
08/11/2016	f	Applied Major Slug Pellets	5	kg/ha
21/03/2017	f	Applied Kieserite - to strips 5, 6, 7, 8, 9, 11, 12, 15, 16, 17, 18, 19 + 20; All Sections	80	kg/ha
29/03/2017	f	Applied SOP - to strips 5, 6, 7, 8, 9, 11, 12, 15, 16, 17, 18, 19 + 20; All Sections	217	kg/ha
11/04/2017	a	Flexitined surrounding fallow areas	-	-
05/06/2017	a	Cut out all paths	-	-
26/06/2017	a	cut all paths	-	-
27/07/2017	a	cut all paths	-	-
25/08/2017	a	Harvested paths	-	-
29/08/2017	a	Baled all discard and remaining swaths	-	-
07/09/2017	a	Baled all remaining commercial swath	-	-
07/09/2017	a	Completed Straw Weights	-	-

W Wheat

27/09/2016	f	Applied FYM - to strips 2.1, 2.2 excluding Section 2	35	t/ha
11/10/2016	s	Drilled WW Crusoe trt Redigo Pro + Deter; Sections 0, 1, 4, 5, 6, 7, 8 + 9	350	seeds/m^2
13/10/2016	p	Sprayed Liberator	1	lt/ha
13/10/2016	p	Sprayed Defy	3	lt/ha
14/03/2017	f	Applied Nitram @ 34.5%N - to strips 12, 17, 18 + 19 excluding Sections 2 and 3	139	kg/ha
15/03/2017	p	Sprayed Pacifica - Sections 0, 1, 4, 5, 6, 7 + 9 only	500	g/ha
15/03/2017	p	Sprayed Chex - Sections 0, 1, 4, 5, 6, 7 + 9 only	250	ml/ha
15/03/2017	p	Sprayed Bio Power - Sections 0, 1, 4, 5, 6, 7 + 9 only	1	lt/ha
05/04/2017	p	Sprayed Artemis - Sections 0, 1, 4, 5, 7, 8 + 9 only	1	lt/ha
05/04/2017	p	Sprayed Claw500 - Sections 0, 1, 4, 5, 7, 8 + 9 only	51	lt/ha
05/04/2017	p	Sprayed Moddus - Sections 0, 1, 4, 5, 7, 8 + 9 only	125	ml/ha
05/04/2017	p	Sprayed 3c Chlormewuat750 - Sections 0, 1, 4, 5, 7, 8 + 9 only	1.25	lt/ha
07/04/2017	f	Applied Nitram @ 34.5%N - to strip 19; Sections 0, 1, 4, 5, 6, 7, 8 + 9	139	kg/ha
07/04/2017	f	Applied Nitram @ 34.5%N - to strips 7, 18; Sections 0, 1, 4, 5, 6, 7, 8 + 9	278	kg/ha
07/04/2017	f	Applied Nitram @ 34.5%N - to strips 2.1, 8, 12; Sections 0, 1, 4, 5, 6, 7, 8 + 9	417	kg/ha
07/04/2017	f	Applied Nitram @ 34.5%N - to strips 1, 9, 10, 11, 13, 14, 17, 20; Sections 0, 1, 4, 5, 6, 7, 8 + 9	556	kg/ha
07/04/2017	f	Applied Nitram @ 34.5%N - to strips 15; Sections 0, 1, 4, 5, 6, 7, 8 + 9	696	kg/ha
07/04/2017	f	Applied Nitram @ 34.5%N - to strips 16; Sections 0, 1, 4, 5, 6, 7, 8 + 9	835	kg/ha
25/04/2017	p	Sprayed Keystone - Sections 0, 1, 4, 5, 7, 8 + 9	600	ml/ha
25/04/2017	p	Sprayed Epic - Sections 0, 1, 4, 5, 7, 8, + 9	400	ml/ha
25/04/2017	p	Sprayed Balear 720 - Sections 0, 1, 4, 5, 7, 8, + 9	700	ml/ha
08/05/2017	f	Applied Nitram - to strips 12, 17, 18, 19; Sections 0, 1, 4, 5, 6, 7, 8 + 9	139	kg/ha
25/05/2017	p	Sprayed, Cortez - sections, 0, 1, 4, 5, 7, 8, + 9	350	ml/ha
25/05/2017	p	Sprayed, Vortex - sections, 0, 1, 4, 5, 7, 8, + 9	1	lt/ha
19/06/2017	p	Sprayed, Fezan, (Tebuconazole)- Sections, 0, 1, 4, 5, 7, 8, + 9	750	ml/ha

28/08/2017	a	harvested all WW plots for grain yield	-	-
29/08/2017	a	Chopped Straw using Claas Tucano back onto Section 0	-	-
02/09/2017	a	Straw Weights on Sections 8 & 5	-	-
07/09/2017	a	Straw Weights on Sections 1	-	-

W Oats

11/10/2016	a	Drilled Mascani trt Beret Gold; Section 2 only	350	seeds/m^2
08/11/2016	p	Sprayed Excalibur - Section 2 only	180	gm/ha
08/11/2016	p	Sprayed Hallmark - Section 2 only	50	ml/ha
10/05/2017	p	Sprayed Cyflamid - Section 2 only	150	ml/ha
10/05/2017	p	Sprayed Envoy - Section 2 only	1	lt/ha
10/05/2017	p	Sprayed Stabilan - Section 2 only	2	lt/ha
28/08/2017	a	harvested all OW plots for grain yield	-	-
07/09/2017	a	Straw Weights on Sections 2	-	-

Maize

27/09/2016	f	Applied FYM - to strips 2.1, 2.2; Not Section 2	35	t/ha
12/04/2017	a	Drilled Severus Maize trt Mesurol - Section 3 only	10	seeds/m^2
08/05/2017	f	Applied Nitram @ 34.5%N - to strip 19; Section 3 only	139	kg/ha
08/05/2017	f	Applied Nitram @ 34.5%N - to strips 7, 18; Section 3 only	278	kg/ha
08/05/2017	f	Applied Nitram @ 34.5%N - to 2.1, 8, 12; Section 3 only	417	kg/ha
08/05/2017	f	Applied Nitram @ 34.5%N - to strips 1, 9, 10, 11, 13, 14, 17; Section 3 only	556	kg/ha
08/05/2017	f	Applied Nitram @ 34.5%N - to strips 15; Section 3 only	696	kg/ha
08/05/2017	f	Applied Nitram @ 34.5%N - to strips 16; Section 3 only	835	kg/ha
24/05/2017	f	Applied Nitram @ 34.5%N - to strip 19; Section 3 only	139	kg/ha
24/05/2017	f	Applied Nitram @ 34.5%N - to strip 18; Section 3 only	278	kg/ha
24/05/2017	f	Applied Nitram @ 34.5%N - to strip 12; Section 3 only	417	kg/ha
24/05/2017	f	Applied Nitram @ 34.5%N - to strip 17; Section 3 only	556	kg/ha
12/06/2017	p	Sprayed Samson Extra - Section 3 only	750	ml/ha
12/06/2017	p	Sprayed Callisto - Section 3 only	2	lt/ha
14/09/2017	a	Harvested Maize for Yield - Section 3 only	-	-
15/09/2017	a	Cut all remaining maize – Section 3 only	-	-
19/09/2017	a	Baled and removed maize – Section 3 only	-	-

Wilderness

20/12/2016 a Topped Broadbalk wilderness

NOTE: Samples of grain and straw were taken for chemical analysis. Unground grain and straw samples from selected treatments were archived.

YIELDS

WINTER WHEAT

Grain Tonnes/Hectare (85% DM)

Tables of means

Section Plot	5/W1	4/W2	7/W3	6/W40	0/W13	1/W51	9/W59	8/W1	Mean
01 (FYM) N4	9.94	7.83	5.67	5.36	-	-	-	-	7.20
21 FYM N3	10.49	9.51	6.43	5.78	4.48	4.61	7.12	5.00	6.68
22 FYM	7.10	6.40	6.37	6.48	4.34	4.63	6.37	6.18	5.98
03 NIL	2.27	1.00	1.26	1.54	0.74	0.68	0.44	3.26	1.40
05 (P) KMg	2.00	1.20	1.78	1.38	1.13	0.96	0.97	5.44	1.86
06 N1 (P) KMg	4.29	2.77	3.02	3.28	2.11	2.13	3.43	5.40	3.30
07 N2 (P) KMg	6.53	4.12	3.55	4.25	2.67	2.57	4.03	5.05	4.09
08 N3 (P) KMg	8.09	4.75	3.76	4.76	3.85	2.98	4.96	6.42	4.95
09 N4 (P) KMg	9.06	5.88	4.04	5.88	3.20	2.69	3.96	7.82	5.32
10 N4	7.35	2.04	3.00	2.95	1.81	1.35	2.48	3.15	3.02
11 N4 PMg	7.67	5.46	3.01	4.44	3.34	2.37	3.07	4.39	4.22
12N1+3+1 (P) KMg	10.38	7.85	5.39	6.39	4.18	3.72	5.46	7.04	6.30
13 N4 PK	9.22	4.90	3.96	5.97	3.71	2.49	4.94	5.66	5.11
14 N4 PK* (Mg*)	8.69	5.10	4.42	6.51	4.55	4.15	5.51	6.79	5.71
15 N5 (P) KMg	9.82	4.88	4.78	6.32	3.68	3.60	4.39	5.30	5.35
16 N6 (P) KMg	10.41	7.02	4.88	6.91	4.62	4.16	4.26	4.61	5.86
17 N1+4+1PKMg	10.64	8.23	5.12	7.12	4.90	4.42	6.03	2.53	6.13
18 N1+2+1PKMg	8.89	5.86	4.46	5.56	4.30	3.51	4.89	3.19	5.08
19 N1+1+1KMg	7.55	3.56	5.30	3.83	3.88	3.09	5.27	3.86	4.54
20 N4 KMg	-	-	-	-	0.81	0.37	-	-	0.59
Mean	7.92	5.18	4.22	4.99	3.28	2.87	4.31	5.06	4.73

Grain Mean DM% 88.0

Straw Tonnes/Hectare

Tables of means

Section Plot	5/W1	4/W2	7/W3	6/W40	0/W13	1/W51	9/W59	8/W1	Mean
01 (FYM) N4	4.05	-	-	-	-	-	-	-	4.05
21 FYM N3	5.18	-	-	-	-	2.98	-	3.23	3.80
22 FYM	3.21	-	-	-	-	2.63	-	5.51	3.79
03 NIL	0.54	-	-	-	-	0.50	-	2.06	1.03
05 (P) KMg	0.36	-	-	-	-	0.54	-	4.04	1.65
06 N1 (P) KMg	0.92	-	-	-	-	0.96	-	4.42	2.10
07 N2 (P) KMg	1.53	-	-	-	-	1.43	-	4.07	2.35
08 N3 (P) KMg	2.02	-	-	-	-	1.45	-	4.87	2.78
09 N4 (P) KMg	2.38	-	-	-	-	1.30	-	4.85	2.84
10 N4	1.72	-	-	-	-	1.01	-	2.37	1.70
11 N4 PMg	1.80	-	-	-	-	1.52	-	3.79	2.37
12N1+3+1 (P) KMg	3.50	-	-	-	-	2.40	-	5.20	3.70
13 N4 PK	2.42	-	-	-	-	1.36	-	4.40	2.72
14 N4 PK* (Mg*)	2.19	-	-	-	-	2.03	-	4.81	3.01
15 N5 (P) KMg	3.63	-	-	-	-	2.33	-	4.46	3.47
16 N6 (P) KMg	4.60	-	-	-	-	2.98	-	4.97	4.18
17 N1+4+1PKMg	5.20	-	-	-	-	2.61	-	4.78	4.20
18 N1+2+1PKMg	2.79	-	-	-	-	2.07	-	5.25	3.37
19 N1+1+1KMg	2.67	-	-	-	-	1.94	-	4.68	3.10
20 N4 KMg	-	-	-	-	-	0.41	-	-	0.41
Mean	2.67	-	-	-	-	1.71	-	4.32	2.87

Straw Mean DM% 89.50

WINTER OAT

Tonnes/Hectare (85% DM)

Table of means

Plot	Treatment	Grain	Straw
12	01(FYM)[N4]	6.69	4.81
212	21[FYMN3]	8.08	6.91
222	22[FYM]	8.68	7.45
32	03Nil	2.53	1.36
52	05(P)KMg	3.08	1.71
62	06[N1](P)KMg	3.28	1.79
72	07[N2](P)KMg	4.24	1.90
82	08[N3](P)KMg	4.43	2.26
92	09[N4](P)KMg	3.49	1.83
102	10[N4]	4.52	2.02
112	11[N4]PMg	5.22	3.08
122	12[N1+3+1](P)KMg	4.24	2.53
132	13[N4]PK	3.74	2.09
142	14[N4]PK*(Mg*)	4.19	2.00

152	15[N5](P)KMg	5.27	2.80
162	16[N6](P)KMg	5.72	3.26
172	17[N1+4+1]PKMg	5.34	3.03
182	18[N1+2+1]PKMg	2.89	1.50
192	19[N1+1+1]KMg	2.61	1.18
	Mean	4.64	2.82

Plot Area Harvested 0.00463

MAIZE

TONNES/HECTARE (100% DM)

Tables of means

Plot	Treatment	Whole Crop
13	01(FYM)N4	11.02
213	21FYMN3	14.40
223	22FYM	17.83
33	03Nil	1.95
53	05(P)KMg	5.01
63	06N1(P)KMg	8.70
73	07N2(P)KMg	10.92
83	08N3(P)KMg	11.17
93	09N4(P)KMg	10.98
103	10N4	4.22
113	11N4PMg	6.49
123	12N2+3(P)KMg	14.21
133	13N4PK	14.45
143	14N4PK*(Mg*)	14.08
153	15N5(P)KMg	12.89
163	16N6(P)KMg	12.91
173	17N2+4PKMg	10.79
183	18N2+2PKMg	12.79
193	19N2+1KMg	7.20
	MEAN	10.63

Mean DM% 25.7

PLOT AREA HARVESTED 0.00189

Section 8 Wheat Yields: Clean Grain (2.0-3.5mm), Tonnes/Hectare, after removing weed seed

YEAR	2017
SECTION	8/W1
PLOT	
2.1 FYMN3	4.49
2.2 FYM	5.69
03 Nil	3.13
05 (P)KMg	4.97
06 N1(P)KMg	4.89
07 N2(P)KMg	4.68
08 N3(P)KMg	5.91
09 N4(P)KMg	7.31
10 N4	2.94
11 N4PMg	3.96
12 N1+3+1(P)K2Mg2	6.37
13 N4PK	5.23
14 N4PK*(Mg*)	6.04
15 N5(P)KMg	4.81
16 N6(P)KMg	3.80
17 N1+4+1PKMg	2.32
18 N1+2+1PKMg	2.85
19 N1+1+1KMg	3.52
Mean	4.61

Note: All clean grain yields for section 8 are reported for the 2 - 3.5mm grain size fraction, excluding grain <2mm, as was the practice prior to 2012.

17/R/HB/2 HOOS BARLEY (Hoosfield)

Object: To study the effects of organic manures and inorganic fertilizers on continuous spring barley. From 1968 to 1978 a rotation of potatoes, beans and spring barley was practised on parts of the experiment. The rotation was discontinued in 1979 and the whole experiment reverted to continuous spring barley. The experiment was modified for 2003. The main plots continue as previously. The Silicate Test plots continue but are not split to test rates of N (basal N is applied). The remaining plots are to be used to study the effect on yield of P residues, (basal N applied).

The 166th year, spring barley.

For previous years see 'Details' 1967 and 1973, Station Report for 1966 and Yield Books for 74-16/R/HB/2.

Main plots

Treatments:

Whole plots

MANURE		**Fertilizers and Organic Manures:-**		
	Plot	Form of N 1852-1966	Additional treatments 1852-2002	Treatments since 2003
---	11	None	-	-
-P-	21	None	P	(P)
--K	31	None	K (Na) Mg	K(Mg)
-PK	41	None	PK (Na) Mg	(P) K (Mg)
A--	12	A	-	-
AP-	22	A	P	(P)
A-K	32	A	K (Na) Mg	K(Mg)
APK	42	A	PK (Na) Mg	(P) K (Mg)
D1852	72	None	D	D
(D)	71	None	(D)	(D)
(A)	62	None	(Ashes)	(Ashes)
-	61	None	-	-
D2001 [a]	73[a]	-	D	D
P2KMg [a]	63 [a]	-	P2KMg	P2KMg

[a] Plots 63 and 73 started in 2001

Form of N: A, sulphate of ammonia to supply 48kg N

P: 35 kg P as triple superphosphate in 1974 and from 1988 to 2002, single superphosphate in other years

(P): (none), P application to be reviewed for 2018

P2: 44kg P as triple superphosphate

K: 90 kg K as sulphate of potash

(Na): (none), 16 kg Na as sulphate of soda until 1973

Mg: 35kg Mg as kieserite every third year since 1974 (applied at 30 kg in 1992, 1995 and 1998) (sulphate of magnesia annually until 1973). Annually to new plot 63.

(Mg): (none), Mg application to be reviewed for 2021

D1852: Farmyard manure at 35t since 1852
D2001: Farmyard manure at 35t since 2001
(D): Farmyard manure 1852 – 1871 only
(Ashes): Weed ash 1852-1916, furnace ash 1917-1932, none since

Sub-Plots

(2) N Nitrogen fertilizer (kg N), as 'Nitro-Chalk', since 1968 (cumulative N applications until 1973, on a cyclic system since 1974):

0
48
96
144

Silicate Test plots

Treatments:

Whole plots

MANURE	**Plot**	**Fertilizers:-** Additional treatment 1852-1979	Changes since 1980	Treatments since 2003
N----	131	-	-	N3
NP---	231	P	-	N3 (P)
N-K--	331	K(Na)Mg	-	N3 K(Mg)
NPK--	431	PK(Na)Mg	-	N3(P)K(Mg)
N—S-	134	Si	Si omitted	N3 (Si)
NP-S-	234	P Si	Si omitted	N3(P) (Si)
N-KS-	334	K(Na)MgSi	Si omitted	N3 K(Mg)(Si)
NPKS-	434	PK(Na)MgSi	Si omitted	N3(P)K(Mg)(Si)
N---S	132	-	Si added	N3 Si
NP--S	232	P	Si added	N3(P) Si
N-K-S	332	K(Na)Mg	Si added	N3 K(Mg) Si
NPK-S	432	PK(Na)Mg	Si added	N3(P)K(Mg) Si
N--SS	133	Si	-	N3 Si
NP-SS	233	P Si	-	N3(P) Si
N-KSS	333	K(Na)MgSi	-	N3 K(Mg) Si
NPKSS	433	PK(Na)MgSi	-	N3(P)K(Mg) Si

N: From 1852-1966 whole plots received 48kg N as nitrate of soda. Between 1968-2002 whole plots were split to test 4 rates of N as "Nitro-chalk" (cumulative applications until 1973, on a cyclic system from 1974).
N3: Basal N, 144kg as "Nitro-chalk" since 2003
Si: Silicate of soda at 450kg (Note: S also refers to silicate of soda)
(Si): Silicate of soda omitted since 1980
P, (P), K, Mg, (Mg), (Na): as above

Phosphorus Test plots

Treatments:

Since 2003 the remaining plots [ex-Castor meal (plots 14, 24, 34 & 44) and those testing combinations of NPK with and without Mg (plots 55, 56, 57 & 58)] have been used to study the effect of P residues on yield. Previous treatments have resulted in different levels of available P in the soil. Large dressings of K were applied to some plots to increase levels of exchangeable K in the soil such that K should not limit yield; plots 141 and 241 were sacrificed and used as discard areas so that the K application did not encroach on adjacent no K plots on the Silicate Test. Other plots received the normal rate of K. The level of exchangeable Mg in the soil is such that Mg should not limit yield; the need to apply Mg was reviewed for 2017.

Whole plots

Manure

Plot	Treatment since 2003
142	N3K*
143	N3K*
144	N3K*
242	N3K*
243	N3K*
244	N3K*
341	N3K
342	N3K
343	N3K
344	N3K
441	N3K
442	N3K
443	N3K
444	N3K
551	N3K
552	N3K
561	N3K
562	N3K
571	N3K*
572	N3K*
581	N3K*
582	N3K*

N3: Basal N, 144kg as “Nitro-chalk”

K: 90kg K as sulphate of potash

K*: 450kg K as sulphate of potash

In 2005 the extra dressings of K (i.e. K*) was stopped and all of the P test plots reverted to K

Experimental Diary

Date		Application	Rate	Units
11/10/2016	a	Ploughed - thrown South	-	-
15/10/2016	p	Sprayed Buffalo Elite	1	lt/ha
15/10/2016	p	Sprayed Samurai	3	lt/ha
31/10/2016	f	Applied SOP to Plots 141 - 144, 241 - 244, 311 - 344, 411 - 444, 551 - 582, 631 - 634	217	kg/ha
31/10/2016	f	Applied Kieserite to Plots 631 - 634	233	kg/ha
31/10/2016	f	Applied TSP to Plots 631 - 634	215	kg/ha
08/11/2016	f	Applied Silicate of Soda to Plots 433, 333, 233, 133, 432, 332, 232 and 132	450	kg/ha
10/11/2016	f	Applied FYM to Plots 721 to 734	35	t/ha
07/03/2017	p	Sprayed Buffalo Elite	1	lt/ha
07/03/2017	p	Sprayed Samurai	3	lt/ha
12/03/2017	a	Cousin Combi Harrowed	-	-
15/03/2017	s	Drilled KWS Irina trt With Raxil Star	350	seeds/m^2
17/03/2017	a	Ring Rolled	-	-
12/05/2017	a	Rotavated Paths	-	-
22/05/2017	p	Sprayed Hallmark	50	ml/ha
23/05/2017	f	Applied Nitrochalk (27% N) to Plots 113, 124, 211,222, 313, 321, 412, 421, 611, 621, 631, 712, 721, 732	48	kg/ha
23/05/2017	f	Applied Nitrochalk (27% N) to Plots 112, 123, 212, 223, 314, 324, 414, 422, 613, 624, 634, 711, 722, 731	96	kg/ha
23/05/2017	f	Applied Nitrochalk (27% N) to Plots 114, 122, 213, 224, 312, 323, 411, 424, 612, 622, 632, 714, 723, 733	144	kg/ha
24/05/2017	a	Rotavated Paths	-	-
24/05/2017	f	Applied Nitram to Series AA (except 621 to 624, 721 to 724), C and Strip 5	417	kg/ha
30/05/2017	p	Sprayed Refine Max	75	g/ha
30/05/2017	p	Sprayed Kingdom	1.25	lt/ha
30/05/2017	p	Sprayed Hurler	700	ml/ha
14/07/2017	a	Cut Paths	-	-
28/07/2017	a	Pulled 7 Wild Oats from within plots	-	-
29/08/2017	a	Harvested plots for yield & baled all discard and remaining swaths.	-	-

Yields

Main Plots

Grain Yield, tonnes/hectare

Table of means

N	0	48	96	144	Mean
MANURE					
---	1.43	1.13	0.95	1.14	1.16
-P-	2.50	3.94	3.78	3.92	3.53
--K	1.45	1.45	1.76	1.49	1.54
-PK	2.41	3.47	3.80	4.81	3.62
A--	0.95	1.36	1.10	1.08	1.12
AP-	2.86	3.94	4.44	4.13	3.84
A-K	0.95	0.97	1.26	1.12	1.07
APK	2.51	3.56	4.01	4.88	3.74
FYM1852onwards	8.04	8.07	7.92	7.91	7.99
FYM1852-1871	2.87	2.99	3.11	5.61	3.64
(A)	1.66	2.03	3.38	1.98	2.26
-	1.27	1.40	1.52	1.41	1.40
FYM2001onwards	6.66	6.92	7.09	6.93	6.90
P2K	3.62	4.78	4.86	5.63	4.72
Mean	2.80	3.28	3.5	3.72	3.33
Grain mean DM%	85.9				

Straw Yield, tonnes/hectare

Table of means

N	0	48	96	144	Mean
MANURE					
---	0.32	0.25	0.19	0.17	0.23
-P-	0.38	0.69	0.72	0.79	0.65
--K	0.25	0.25	0.29	0.28	0.27
-PK	0.39	0.73	1.00	1.30	0.86
A--	0.20	0.22	0.24	0.21	0.22
AP-	0.61	0.84	1.05	0.95	0.86
A-K	0.16	0.18	0.19	0.20	0.18
APK	0.65	0.82	1.00	1.46	0.98

FYM1852onwards	3.86	3.35	3.81	3.16	3.54
FYM1852-1871	0.64	0.70	0.63	1.73	0.92
(A)	0.26	0.41	0.61	0.13	0.35
-	0.32	0.27	0.20	0.36	0.29
FYM2001onwards	3.30	2.98	2.90	2.69	2.97
P2K	1.21	1.52	1.42	1.76	1.48
Mean	0.90	0.94	1.02	1.08	0.99

Grain mean DM% 85.8

PHOSPHATE PLOTS

Grain Yield, tonnes/hectare

Tables of means

PLOTS

142	3.66
143	3.57
144	3.27
242	5.13
243	4.82
244	4.84
341	3.50
342	4.12
343	4.23
344	4.68
441	4.55
442	5.23
443	5.04
444	5.08
551	5.24
552	4.81
561	4.77
562	4.46
571	4.19
572	4.69
581	0.99
582	1.08
Mean	4.18
Grain Mean DM%	86.7
Plot area Harvested	0.00244

SILICATE PLOTS

Grain Yield, tonnes/hectare

Tables of means

PK	N3--	N3P-	N3-K	N3PK	Mean
Silicate					
(-)-	1.34	4.26	1.24	4.99	2.96
(Si)-	1.89	4.99	2.63	5.11	3.65
(-)Si	2.54	5.11	2.34	5.14	3.78
(Si)Si	2.81	5.00	3.06	4.81	3.92
Mean	2.15	4.84	2.32	5.01	3.58
Grain Mean DM%	86.3				
Plot area harvested	0.00244				

17/R/WF/3 WHEAT AND FALLOW (Hoosfield)

Object: To maintain a low plant available P site – Hoosfield.

Whole plot dimensions: 9 x 211

Treatments:

Two plots, one sown to winter wheat, one fallow; alternating in successive years. From 2016 this experiment was converted to continuous wheat on both plots, with no yields or samples taken at harvest. For previous years see 'Details' 1967, 1973 and Yield Books for 74-16/R/WF/3.

Experimental Diary

Date		Application	Rate	Units
28/09/2016	a	Ploughed - thrown North	-	-
02/10/2016	p	Sprayed Buffalo Elite	1	lt/ha
02/10/2016	p	Sprayed Samurai	3	lt/ha
06/10/2016	a	Cultipressed All Ground	-	-
10/10/2016	a	Ring Rolled All New Drilling		
10/10/2016	s	Drilled Crusoe trt w/Redigo Pro + Deter	350	seed/m^2
10/10/2016	a	Cultipressed -all sites and surrounds	-	-
15/10/2016	p	Sprayed Liberator	600	ml/ha
15/10/2016	p	Sprayed Defy	3	lt/ha
15/10/2016	p	Sprayed Deploy	400	ml/ha
02/12/2016	p	Sprayed Hallmark	50	ml/ha
04/04/2017	f	Applied Nitram	145	kg/ha
05/04/2017	p	Sprayed Artemis	1	lt/ha
05/04/2017	p	Sprayed Claw 500	1	lt/ha
05/04/2017	p	Sprayed 3C Chlormequat 750	2	lt/ha
27/04/2017	p	Sprayed keystone	600	ml/ha
27/04/2017	p	Sprayed epic	400	ml/ha
27/04/2017	p	Sprayed balear 720sc	700	ml/ha
19/06/2017	p	Sprayed Fezan (Tebuconazole)	750	ml/ha
24/08/2017	a	Harvested wheat	-	-
07/09/2017	a	Straw baled and removed	-	-

17/R/EX/4 EXHAUSTION LAND (Hoosfield)

Object: To study the residual effects of manures applied 1856 - 1901, and of additional phosphate applied since 1986 (P test) and of additional potassium since 2007 (K test); on the yield of continuous spring barley up to 1991, winter wheat since – Hoosfield.

The 162nd year, winter wheat.

For previous years see 'Details' 1977, 1973 and Yield Books for 74-16/R/EX/4

Treatments: All combinations of:

Whole plots (P test)

1.	**OLD RES**	Residues of manures applied annually 1876 – 1901:

Main plot

01	O	None
03	D	Farmyard manure at 35 t
05	N	96 kg N as ammonium salts
09	P	34 kg P as superphosphate
07	NPKNaMg	N and P as above plus 137 kg K as sulphate of potash, 16 kg Na as sulphate of soda, 11 kg Mg as sulphate of magnesia

2.	P	Maintenance P (20 kg P) applied annually from 2000

to maintain existing levels of available P In the soil. In 2009 maintenance P applications were changed from 20 kg P/ha to 15 kg P/ha. This was not recorded in the yield books for 2009-13. (P1) (P2) and (P3) are residues of P applied annually. From 2016 onward P was withheld from the P(P1) sub-plots.

1986–1992:

	2016-Present	2009-2015	2000-08	1986-92
O	None	None	None	None
P (P1)	None	15 kg P	20 kg P	44 kg P
P (P2)	15 kg P	15 kg P	20 kg P	87 kg P
P (P3)	15 kg P	15 kg P	20 kg P	131 kg P

NOTE: P treatments were applied at 61.5 kg P in error in 2000.

Plus

Whole plots (K test, previously N test until 1991)

1.	**OLD RES**	Residues of manures applied annually 1876 – 1901:

Main Plot

02	O	None
04	D	Farmyard manure at 35 t
06	N*	96 kg N as nitrate of soda
10	PK	34 kg P as superphosphate, 137 kg K as sulphate of potash
08	N*PK	N, P and K as above

2. K Potassium applied annually from 2007 as muriate of potash

O	None (2 sub-plots within each treatment strip)
K1	75 kg K2O (62.2 kg K)
K2	150 kg K2O (124.5 kg K)

Whole plots

Nitrogen: 50 kg N as ammonium sulphate (to supply sufficient S) during first two weeks in March, 200 kg N as ammonium nitrate at GS31/mid-April (whichever comes first) and 50 kg N as ammonium nitrate at GS37 (not later than mid-May).

Experimental Diary

Date		Application	Rate	Units
26/09/2016	a	Topped all stubble	-	-
26/09/2016	f	Applied TSP to plots 101-104, 081-084, 061-064, 041-044, 021-024, 091-092, 071-072, 051-052, 031-032 and 011-012	75	kg/ha
26/09/2016	f	Applied MOP to plots 103, 083, 063,043, 023	125	kg/ha
26/09/2016	f	Applied MOP onto plots 104-094, 084-074, 064-054, 044-034 and 024-014	250	kg/ha
28/09/2016	a	Ploughed - thrown North	-	-
06/10/2016	a	Cultipressed - all ground and immediate surrounds	-	-
10/10/2016	a	Ring Rolled All New Drilling	-	-
10/10/2016	s	Drilled Crusoe Treated w/Redigo Pro + Deter	350	seeds/m^2
10/10/2016	a	Cultipressed - all sites and surrounds	-	-
15/10/2016	p	Sprayed Liberator	600	ml/ha
15/10/2016	p	Sprayed Defy	3	lt/ha
15/10/2016	p	Sprayed Deploy	400	ml/ha
02/12/2016	p	Sprayed Hallmark	50	ml/ha
14/03/2017	f	Applied Sulphate of Ammonia (21%N 60%SO3) to all plots	238	kg/ha

21/03/2017	f	Applied Kieserite	80	kg/ha
04/04/2017	f	Applied Nitram	580	kg/ha
05/04/2017	p	Sprayed Artemis	1	lt/ha
05/04/2017	p	Sprayed Claw 500	1	lt/ha
05/04/2017	p	Sprayed 3C Chlormequat 750	2	lt/ha
27/04/2017	p	Sprayed keystone	600	ml/ha
27/04/2017	p	Sprayed epic	400	ml/ha
27/04/2017	p	Sprayed balear 720sc	700	ml/ha
05/05/2017	f	Applied Nitram (34.5% N)	145	kg/ha
08/06/2017	a	Cut Paths	-	-
19/06/2017	p	Sprayed Fezan (Tebuconazole)	750	ml/ha
26/06/2017	a	cut all paths	-	-
27/07/2017	a	cut all paths	-	-
01/09/2017	a	Harvested All Plots	-	-
02/09/2017	a	Completed Straw Samples and Weights	-	-
06/09/2017	a	harvested leftover wheat of harvested trials and surrounds	-	-
07/09/2017	a	Baled all remaining commercial swath	-	-

Yields

P TEST

Grain Yield, tonnes/hectare

Tables of means

P_RES OLD_RES	O	(P1)	(P2)	(P3)	Mean
O	1.87	4.18	5.69	6.14	4.47
D	3.49	6.23	7.49	7.68	6.22
N	1.76	5.19	6.56	7.74	5.31
P	2.44	5.66	7.28	7.31	5.67
NPKNAMG	3.22	5.86	6.47	7.12	5.67
Mean	2.56	5.43	6.70	7.20	5.47

Grain mean DM% 86.4

Straw Yield, tonnes/hectare

Tables of means

P_RES OLD_RES	O	(P1)	(P2)	(P3)	Mean
O	1.01	1.76	2.65	3.05	2.12
D	1.78	2.86	3.58	3.36	2.89
N	1.23	2.81	3.66	2.78	2.62
P	0.93	2.15	2.68	3.02	2.20
NPKNAMG	1.40	2.37	2.69	3.16	2.40
Mean	1.27	2.39	3.05	3.07	2.45

Straw mean DM%	96.2

Plot area harvested 0.00512.

K TEST

Grain Yield, tonnes/hectare

Tables of means

K_Test OLD_RES	K0	K1	K2	Mean
O	6.54	7.80	7.52	7.10
D	7.02	8.52	8.07	7.66
N*	7.04	7.96	8.19	7.56
PK	8.37	7.86	8.23	8.21
N*PK	7.81	7.48	8.14	7.81
Mean	7.36	7.92	8.03	7.67

Grain mean DM%	86.6

Straw Yield, tonnes/hectare

Tables of means

K_Test OLD_RES	K0	K1	K2	Mean
O	2.31	3.65	3.68	2.99
D	2.62	3.55	3.51	3.08
N*	2.65	3.73	3.77	3.2
PK	3.20	3.15	3.30	3.21
N*PK	2.99	1.99	2.95	2.73
Mean	2.76	3.21	3.44	3.04

Straw mean DM%	97.0

Plot area harvested 0.00512

17/R/PG/5 PARK GRASS

Object: To study the effects of organic manures and inorganic fertilisers and lime on old grass for hay.

The 162nd year, hay.
For previous years see 'Details' 1977 and 1973 and Yield Books for 74-16/R/PG/5.

Treatments: Combinations of:

Whole plots

1. **Manure** Fertilizers and organic manures:

N1	Plot 1	N1
K	Plot 2/1	K since 1996 (as 2/2 before)
None (FYM)	Plot 2/2	None (FYM until 1863)
None	Plot 3	None
P	Plot 4/1	P
N2P	Plot 4/2	N2 P
N1PKNaMg	Plot 6	N1 P K Na Mg
(P)KNaMg	Plot 7/1	K Na Mg (+P until 2012)
PKNaMg	Plot 7/2	P K Na Mg
PNaMg	Plot 8	P Na Mg
PKNaMg(N2)	Plot 9/1	P K Na Mg (+ N2 until 1989)
N2PKNaMg	Plot 9/2	N2 P K Na Mg
N2PNaMg	Plot 10	N2 P Na Mg
N3PKNaMg	Plot 11/1	N3 P K Na Mg
N3PKNaMgSi	Plot 11/2	N3 P K Na Mg Si
None	Plot 12	None
(FYM/F)	Plot 13/1	None (FYM/F until 1993/1995)
FYM/PM	Plot 13/2	FYM/PM (FYM/F until 1999)
PKNaMg (N2*)	Plot 14/1	P K Na Mg (+ N2* until 1989)
N2*PKNaMg	Plot 14/2	N2* P K Na Mg
N3*PKNaMg (N2*)	Plot 15	N3*P K Na Mg (N2* until 1875; P K Na Mg 1876-2012)
N1*PKNaMg	Plot 16	N1* P K Na Mg
N1*	Plot 17	N1*
N2KNaMg	Plot 18	N2 K Na Mg
FYM	Plot 19	FYM
FYM/N*PK	Plot 20	FYM/N*P K

N1, N2, N3:	48, 96, 144 kg N as sulphate of ammonia
N1*, N2*, N3*:	48, 96, 144 kg N as nitrate of soda (30 kg N to plot 20 in years with no farmyard manure). In 2013 plot 15 started to receive 144 kg N/ha as nitrate of soda to provide a comparison with plot 11/1, which receives 144 kg N/ha as sulphate of ammonia.

P:	17 kg P/ha applied as triple superphosphate since 2017, except for plot 20 which receives 15 kg P/ha in years with no farmyard manure. Prior to this, 35 kg P (15 kg P to plot 20 in years with no farmyard manure) was applied as triple superphosphate in 1974 and since 1987, single superphosphate in other years.
(P):	In 2013 plot 7 was split into 7/1 & 7/2. P was withheld from plot 7/1 but 7/2 continues to receive P as above.
K:	225 kg K (45 kg K to plot 20 in years with no farmyard manure) as sulphate of potash
Na:	15 kg Na as sulphate of soda
Mg:	10 kg Mg as sulphate of magnesia
Si:	Silicate of soda at 450 kg
FYM:	Farmyard manure at 35 t every fourth year
F:	Fishmeal every fourth year to supply 63 kg N (stopped 1999; replaced by PM)
PM	Pelleted poultry manure at 2 t, every fourth year to supply 63 kg N (started 2003)

Sub-plots

2.	**Lime**	**Liming plots 1-18 (excluding 18/2):**
	a	Ground chalk applied as necessary to achieve pH7
	b	Ground chalk applied as necessary to achieve pH6
	c	Ground chalk applied as necessary to achieve pH5
	d	None

NOTE: A small amount of chalk was applied to all plots during tests in the 1880s and 1890s. A regular test of liming was started in 1903 when most plots were divided in two and 4 t ha^{-1} $CaCO_3$ was applied every four years to the southern half. In 1965, most plots were divided into four: sub-plots “a” and “b” on the previously limed halves and sub-plots “c” and “d” on the unlimed halves. Sub-plots “a”, “b” and “c” now receive different amounts of chalk, when necessary, to achieve and/or maintain soil (0-23cm) at pH 7, 6 and 5, respectively. Sub-plot “d” receives no lime and its pH reflects inputs from the various treatments and the atmosphere. Lime was last applied in 2014-2015; the eighth application in a triennial scheme of soil pH analysis and remedial chalk applications.

[This note was incorrect in earlier Yield book entries.]

NOTE: A separate scheme of liming was introduced on plots 18, 19 & 20 in 1920; subplot /1, /2 and /3 receive no lime, “high” lime and “light” lime respectively every 4 years. Since 1965 plot 18-1 has been split into two for treatments ‘c’ and ’d’ as above and plot 18-3 split into two for treatments ‘a’ and ‘b. Plots 19 and 20 received no further chalk after 1968; plot 18/2 no further chalk after 1972.

[This note was incorrect in earlier Yield book entries. See further details on the e-RA website at http://www.era.rothamsted.ac.uk]

Experimental Diary

Date		Application	Rate	Units
17/10/2016	a	Cut Paths - in and around trial	-	-
20/10/2016	a	Mowed All Grass	-	-
20/10/2016	a	Rowed up All Grass	-	-
25/11/2016	f	Applied TSP - plots 4/1, 4/2, 6, 7/2, 8, 9/1, 9/2, 10, 11/1, 11/2, 14/1, 14/2, 15, 16	73	kg/ha
28/11/2016	f	Applied Sulphate of Potash - plots 2/1, 6, 7/1, 7/2, 9/1, 9/2, 11/1, 11/2, 14/1, 14/2, 15, 16, 18	542	kg/ha
28/11/2016	f	Applied Sulphate of Soda - plots 6, 7/1, 7/2, 8, 9/1, 9/2, 10, 11/1, 11/2, 14/1, 14/2, 15, 16, 18	43	kg/ha
28/11/2016	f	Applied Sulphate of Magnesia (Epsom Salts) - plots 6, 7/1, 7/2, 8, 9/1, 9/2, 10, 11/1, 11/2, 14/1, 14/2, 15, 16, 18	111	kg/ha
28/11/2016	f	Applied Silicate of Soda - plot 11/2	450	kg/ha
30/11/2016	f	Applied FYM - plots 13/2, 19, 20	35	t/ha
18/04/2017	f	Applied Sulphate of Ammonia (21% N) - plot 1, 6a, 6b	229	kg/ha
18/04/2017	f	Applied Sulphate of Ammonia (21% N) - plots 4/2, 9/2, 10, 18	457	kg/ha
18/04/2017	f	Applied Sulphate of Ammonia (21% N) - plots 11/1, 11/2	686	kg/ha
19/04/2017	f	Applied Sodium Nitrate (16% N) - plots 16, 17	300	kg/ha
19/04/2017	f	Applied Sodium Nitrate (16% N) - plot 14/2	600	kg/ha
19/04/2017	f	Applied Sodium Nitrate (16% N) - plot 15	900	kg/ha
10/05/2017	a	Cut All Paths	-	-
23/05/2017	a	Cut paths	-	-
07/06/2017	a	Cut Paths	-	-
19/06/2017	a	Cut Paths and surrounds	-	-
20/06/2017	a	Started harvesting grass yields - 1st Cut	-	-

21/06/2017	a	Completed grass yield - 1st Cut	-	-
21/06/2017	a	Mowed all grass	-	-
23/06/2017	a	Turned all hay	-	-
26/06/2017	a	Rowed up all grass for baling	-	-
19/10/2017	a	Cut Paths	-	-
24/10/2017	a	Started harvesting plot yields - 2nd Cut	-	-
25/10/2017	a	Completed harvesting yield plots - 2nd Cut	-	-
01/11/2017	a	Baled leftover grass and removed	-	-

NOTE: Samples of herbage (1st and 2nd Cut) were taken for chemical analysis. Unground herbage samples from all plots were archived.

Yields

1ST CUT (20-21 JUN 2017) DRY MATTER, TONNES/HECTARE

Tables of means

Grand mean 3.00

Manure	Lime	a	b	c	d	Mean
N1	1	1.42	1.10	0.83	0.31	0.91
K	2/1	0.85	1.44	0.85	0.52	0.91
None(FYM)	2/2	1.63	1.72	0.93	0.88	1.29
None	3	1.44	1.64	0.83	0.82	1.18
P	4/1	2.34	2.69	1.91	1.51	2.11
N2P	4/2	1.87	2.53	2.92	1.28	2.15
N1PKNaMg	6	5.23	5.04	-	-	5.14
(P)KNaMg	7/1	3.84	4.28	3.88	1.78	3.44
PKNaMg	7/2	4.54	5.28	4.90	2.76	4.37
PNaMg	8	2.13	2.62	2.13	2.51	2.35
PKNaMg(N2)	9/1	4.46	3.96	3.97	0.37	3.19
N2PKNaMg	9/2	5.21	5.53	4.11	1.91	4.19
N2PNaMg	10	2.40	2.86	3.09	1.27	2.40
N3PKNaMg	11/1	4.75	4.15	4.44	2.32	3.91
N3PKNaMgSi	11/2	4.96	4.49	4.21	2.49	4.04
None	12	1.71	1.44	1.06	1.03	1.31
(FYM/F)	13/1	2.16	2.45	2.26	1.88	2.19
FYM/PM	13/2	3.81	4.71	4.50	4.63	4.41
PKNaMg(N2*)	14/1	5.20	6.25	5.29	5.32	5.52
N2*PKNaMg	14/2	4.08	4.58	4.46	4.55	4.42
N3*PKNaMg(N2*)	15	5.45	4.78	3.82	3.74	4.45
N1*PKNaMg	16	4.91	5.35	3.90	3.74	4.48
N1*	17	0.87	1.64	1.24	1.77	1.38
N2KNaMg	18	1.33	1.97	1.69	0.08	1.27

N2KNaMg	18/2	2.81
FYM	19/1	4.32
FYM	19/2	4.75
FYM	19/3	4.29
FYM/N*PK	20/1	4.63
FYM/N*PK	20/2	4.48
FYM/N*PK	20/3	4.40

1st cut mean DM% 30.8

2ND CUT (24-25 OCT 2017) DRY MATTER, TONNES/HECTARE

Tables of means

Grand mean **2.01**

Manure		Lime	a	b	c	d	Mean
N1	1		1.67	1.56	1.74	0.61	1.39
K	2/1		1.41	1.28	0.99	0.94	1.15
None(FYM)	2/2		1.24	1.23	1.47	1.32	1.32
None	3		1.03	1.27	1.40	1.31	1.25
P	4/1		1.85	1.86	2.02	2.10	1.96
N2P	4/2		1.51	1.92	1.98	1.24	1.66
N1PKNaMg	6		2.08	2.23	-	-	2.15
(P)KNaMg	7/1		2.05	2.40	2.01	1.37	1.96
PKNaMg	7/2		2.01	2.43	2.47	1.60	2.13
PNaMg	8		1.79	1.83	2.07	2.89	2.15
PKNaMg(N2)	9/1		2.27	2.49	2.18	0.43	1.84
N2PKNaMg	9/2		2.56	2.52	2.03	1.55	2.17
N2PNaMg	10		1.74	1.86	2.61	1.12	1.83
N3PKNaMg	11/1		2.00	2.23	2.39	2.23	2.21
N3PKNaMgSi	11/2		2.90	2.48	2.15	1.85	2.35
None	12		1.96	1.63	1.20	1.20	1.50
(FYM/F)	13/1		2.48	2.69	2.10	1.73	2.25
FYM/PM	13/2		2.32	3.11	2.72	2.80	2.74
PKNaMg(N2*)	14/1		2.14	2.92	3.22	3.11	2.85
N2*PKNaMg	14/2		1.82	2.37	2.62	2.71	2.38
N3*PKNaMg(N2*)	15		2.26	2.31	2.83	2.65	2.51
N1*PKNaMg	16		2.37	2.90	2.64	2.24	2.54
N1*	17		1.59	1.82	1.64	1.91	1.74
N2KNaMg	18		1.48	1.34	1.27	0.46	1.14
N2KNaMg	18/2						1.68
FYM	19/1						3.04
FYM	19/2						3.22
FYM	19/3						2.90
FYM/N*PK	20/1						2.85
FYM/N*PK	20/2						2.94
FYM/N*PK	20/3						2.92

2nd cut mean DM% 25.13

TOTAL OF 2 CUTS DRY MATTER, TONNES/HECTARE

Tables of means

Grand mean 5.00

Manure		Lime	a	b	c	d	Mean
N1	1		3.09	2.65	2.56	0.92	2.31
K	2/1		2.25	2.73	1.84	1.46	2.07
None(FYM)	2/2		2.88	2.95	2.40	2.20	2.61
None	3		2.48	2.91	2.23	2.13	2.44
P	4/1		4.18	4.55	3.93	3.61	4.07
N2P	4/2		3.38	4.45	4.91	2.52	3.81
N1PKNaMg	6		7.31	7.27	-	-	7.29
(P)KNaMg	7/1		5.89	6.68	5.88	3.15	5.40
PKNaMg	7/2		6.55	7.72	7.37	4.36	6.50
PNaMg	8		3.92	4.45	4.20	5.40	4.49
PKNaMg(N2)	9/1		6.73	6.45	6.15	0.80	5.03
N2PKNaMg	9/2		7.77	8.05	6.14	3.47	6.36
N2PNaMg	10		4.14	4.73	5.70	2.38	4.24
N3PKNaMg	11/1		6.74	6.38	6.83	4.55	6.13
N3PKNaMgSi	11/2		7.86	6.96	6.36	4.34	6.38
None	12		3.67	3.07	2.26	2.22	2.81
(FYM/F)	13/1		4.64	5.14	4.36	3.61	4.44
FYM/PM	13/2		6.13	7.82	7.22	7.43	7.15
PKNaMg(N2*)	14/1		7.34	9.17	8.51	8.44	8.36
N2*PKNaMg	14/2		5.90	6.95	7.08	7.26	6.80
N3*PKNaMg(N2*)	15		7.71	7.09	6.65	6.38	6.96
N1*PKNaMg	16		7.28	8.25	6.54	5.99	7.01
N1*	17		2.46	3.46	2.88	3.68	3.12
N2KNaMg	18		2.81	3.31	2.96	0.54	2.41
N2KNaMg	18/2						4.49
FYM	19/1						7.36
FYM	19/2						7.97
FYM	19/3						7.19
FYM/N*PK	20/1						7.48
FYM/N*PK	20/2						7.42
FYM/N*PK	20/3						7.33

TOTAL OF 2 CUTS

Mean DM% 27.98

17/R/GC/8 GARDEN CLOVER (Manor Garden)

Object: To study yields and pathogens of red clover grown continuously - Manor Garden.

The 164th year, red clover.

For previous years see `Details' 1967 and 1973, and Yield books for 74-16/R/GC/8.

Design: 2 blocks of 2 plots.

Whole plot dimensions: 1.00 m x 1.40 m.

Treatments:

Residual effects of fungicide to control *Sclerotinia trifoliorum*:

NONE None

Benomyl sprays during previous winters, last applied November 1989.

Experimental Diary

Date		Application	Rate	Units
01/12/2016	f	Applied Epsom Salts	50	kg/ha
01/12/2016	f	Applied TSP	75	kg/ha
01/12/2016	f	Applied Potassium Sulphate	150	kg/ha
01/12/2016	f	Applied Chalk.	1.25	t/ha
31/05/2017	a	First Cut	-	-
04/07/2017	a	Second Cut	-	-
13/09/2017	a	Third Cut	-	-

Yields

Dry Matter, Tonnes/Hectare

			FUNG_RES		
Cut	Date	Grand Mean	NONE	BENOMYL	Mean DM%
1st	31 MAY 2017	4.09	4.14	4.04	20.10
2nd	04 JUL 2017	3.71	3.65	3.77	23.50
3rd	13 SEP 2017	3.27	3.34	3.20	24.70
Total of 3 cuts		11.06	11.12	11.00	22.80

17/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 80th year, leys, winter beans, winter wheat, winter rye

For previous years see 'Details' 1967 & 1973 and Yield Books for 74-16/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

	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.

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 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:

3. **N** Nitrogen fertilizer as split dressings in spring 2017 (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 2017 (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 winter wheat and long-term leys in the wheat block, applied 2016 (see date below).

Continuous rotations	No FYM	FYM Res
Before wheat	Half plots	Half plots
ABe/Be	100	10
AO/O	110	60
LLn/AO	20	20
LLn/ABe	0	0

None to other plots.

Experimental Diary

Date		Application	Rate	Units
ALL				
26/09/2016	a	Ploughed - thrown north west - to finish	-	-
27/09/2016	a	Ploughed - Finished	-	-
20/04/2017	a	Cut paths	-	-
19/06/2017	a	Cut paths	-	-
11/08/2017	a	Topped Surrounds and paths	-	-
29/09/2017	a	Topped Trial Site	-	-
Grass ley and clover/grass leys (first year leys)				
14/09/2016	f	Applied SOP (50% K2O, 45% SO3)	140.00	kg/ha
14/09/2016	f	Applied Nitram (34.5% N) Fertiliser	145.00	kg/ha
14/09/2016	f	Applied TSP	213.00	kg/ha
26/10/2016	s	Drilled Grass and Clover mix - plots 3, 4, 7, 8	30.00	kg/ha
26/10/2016	s	Drilled Grass only - plots 11, 12, 13, 14	30.00	kg/ha

06/04/2017	f	Applied Nitram (34.5% N) Fertiliser to plots: 11, 12, 13, 14	217.00	kg/ha
07/04/2017	f	Applied MOP to plots: 11, 12, 13, 14	167.00	kg/ha
27/06/2017	a	Cut grass plots for yield (1st cut)	-	-
06/07/2017	a	Mowed all remaining grass on plots	-	-
10/07/2017	a	Baled and removed all remaining grass	-	-
17/11/2017	a	Cut grass plots for yield (2nd Cut)	-	-

Grass ley and clover/grass leys (2nd and 3rd year leys)

14/09/2016	f	Applied SOP (50% K2O, 45% SO3)	140.00	kg/ha
14/09/2016	f	Applied TSP	213.00	kg/ha
06/04/2017	f	Applied Nitram (34.5% N) Fertiliser to plots 25, 26, 31, 32, 57, 58, 61, 62.	217.00	kg/ha
07/04/2017	f	Applied MOP to plots 25, 26, 31, 32, 57, 58, 61, 62.	167.00	kg/ha
27/06/2017	a	Cut grass plots for yield (1st Cut)	-	-
06/07/2017	a	Mowed all remaining grass on plots	-	-
10/07/2017	a	Baled and removed all remaining grass	-	-
17/11/2017	a	Cut grass plots for yield (2nd Cut)	-	-

W Beans

14/09/2016	f	Applied TSP Fertilizer to all arable plots.	127.00	kg/ha
28/10/2016	s	Drilled Beans - Wizard - plots 19, 20, 27, 28, 49, 50, 53, 54	35.00	seeds/m^2
31/10/2016	p	Sprayed Nivana in 200 lt/ha	4.00	lt/ha
06/04/2017	p	Sprayed Troy 480	3.00	lt/ha
07/04/2017	f	Applied SOP (50% K2O, 45% SO3) - to all arable plots	150.00	kg/ha
02/05/2017	p	Sprayed Sprinter in 200 lt/ha water volume	2.00	lt/ha
02/05/2017	p	Sprayed Hallmark in 200 lt/ha water volume	75.00	ml/ha
02/05/2017	p	Sprayed San 703 in 200 lt/ha water volume	2.00	lt/ha
15/08/2017	a	Harvested	-	-

W Wheat

06/09/2016	p	Sprayed Samurai	4.00	lt/ha
06/09/2016	p	Sprayed Firebrand	1.00	lt/ha
14/09/2016	f	Applied TSP Fertilizer to all arable plots.	127.00	kg/ha
19/09/2016	f	Applied MOP Fertiliser - to plots 68. By hand.	10.00	kg/ha
19/09/2016	f	Applied MOP Fertiliser - to plots 71, 72. By hand.	20.00	kg/ha
19/09/2016	f	Applied MOP Fertiliser - to plots 74. By hand.	60.00	kg/ha
19/09/2016	f	Applied MOP Fertiliser - to plots 67. By hand.	100.00	kg/ha
19/09/2016	f	Applied MOP Fertiliser - to plots 73. By hand.	110.00	kg/ha
27/10/2016	s	Drilled Wheat - Crusoe - trt Redigo Pro + Deter - Block 5.	400.00	seeds/m^2
17/03/2017	f	Applied Nitro-chalk - Block 5 - Block 5 excluding plots 653, 663, 672, 682, 692, 702, 713, 721, 732, 744, 751, 763, 771, 782, 791, 803	148.00	kg/ha
07/04/2017	f	Applied SOP (50% K2O, 45% SO3) - to all arable plots	150.00	kg/ha
24/04/2017	f	Applied Nitro-chalk (27.0% N) Block 5 - plots 651, 662, 674, 684, 693, 701, 714, 722, 733, 743, 754, 761, 774, 781, 793, 804	148.00	kg/ha
24/04/2017	f	Applied Nitro-chalk (27.0% N) Block 5 - plots 654, 661, 671, 683, 691, 703, 712, 723, 734, 741, 752, 764, 773, 784, 794, 801	444.00	kg/ha
24/04/2017	f	Applied Nitro-chalk (27.0% N) Block 5 - plots 652, 664, 673, 681, 694, 704, 711, 724, 731, 742, 753, 762, 772, 783, 792, 802	741.00	kg/ha
28/04/2017	p	Sprayed Sprinter	2.00	lt/ha
28/04/2017	p	Sprayed Keystone	0.80	lt/ha
28/04/2017	p	Sprayed Balear 720	0.70	lt/ha
22/05/2017	p	Sprayed Sprinter in 200 lt/ha water volume	2.00	lt/ha

22/05/2017	p	Sprayed Simba SX in 200 lt/ha water volume	30.00	g/ha
22/05/2017	p	Sprayed Hatchet Xtra in 200 lt/ha water volume	0.50	lt/ha
22/05/2017	p	Sprayed Aviator Xpro in 200 lt/ha water volume	0.56	lt/ha
22/05/2017	p	Sprayed Keystone in 200 lt/ha water volume	0.23	lt/ha
22/05/2017	p	Sprayed Cello in 200 lt/ha water volume	0.17	lt/ha
25/03/2017	p	Sprayed Chex	0.25	lt/ha
25/03/2017	p	Sprayed Palio	0.27	lt/ha
25/03/2017	p	Sprayed Eximus	2.00	lt/ha
25/03/2017	p	Sprayed Cogent	1.00	lt/ha
06/04/2017	p	Sprayed Sprinter in 200 lt/ha water volume	2.00	lt/ha
06/04/2017	p	Sprayed Cortez in 200 lt/ha water volume	0.50	lt/ha
06/04/2017	p	Sprayed Chlormequat in 200 lt/ha water volume	2.00	lt/ha
06/04/2017	p	Sprayed Bravo 500 in 200 lt/ha water volume	1.00	lt/ha
15/08/2017	a	Harvested	-	-

W Rye

14/09/2016	f	Applied TSP Fertilizer to all arable plots.	127.00	kg/ha
20/09/2016	f	Applied Chalk to block 3	5.00	t/ha
27/10/2016	s	Drilled Rye - Mephisto trt Kinto - Block 3 - plots 1, 2, 5, 6, 9, 10, 15, 16	350.00	seeds/m^2
25/03/2017	p	Sprayed Chex	0.25	lt/ha
25/03/2017	p	Sprayed Palio	0.27	lt/ha
25/03/2017	p	Sprayed Eximus	2.00	lt/ha
25/03/2017	p	Sprayed Cogent	1.00	lt/ha
06/04/2017	p	Sprayed Sprinter in 200 lt/ha water volume	2.00	lt/ha
06/04/2017	p	Sprayed Cortez in 200 lt/ha water volume	0.50	lt/ha
06/04/2017	p	Sprayed Chlormequat in 200 lt/ha water volume	2.00	lt/ha

06/04/2017	p	Sprayed Bravo 500 in 200 lt/ha water volume	1.00	lt/ha
06/04/2017	f	Applied Nitram (34.5% N) Fertiliser - to plots 1, 2, 5, 6, 9, 10, 15, 16	290.00	kg/ha
07/04/2017	f	Applied SOP (50% K2O, 45% SO3) - to all arable plots	150.00	kg/ha
21/04/2017	f	Applied Nitrochalk (27% N) - Block 3 - plots 332, 342, 353, 363, 372, 383, 392, 403, 412, 424, 434, 441, 452, 461, 472, 483	185.00	kg/ha
21/04/2017	f	Applied Nitrochalk (27% N) - Block 3 - plots 331, 343, 351, 361, 373, 384, 394, 401, 414, 422, 432, 444, 453, 462, 471, 484	370.00	kg/ha
21/04/2017	f	Applied Nitrochalk (27% N) - Block 3 - plots 334, 341, 354, 364, 374, 381, 393, 404, 411, 423, 431, 443, 454, 463, 474, 482	556.00	kg/ha
02/05/2017	p	Sprayed Sprinter in 200 lt/ha water volume	2.00	lt/ha
02/05/2017	p	Sprayed Keystone in 200 lt/ha water volume	0.80	lt/ha
24/05/2017	p	Sprayed Sprinter in 200 lt/ha water volume	2.00	lt/ha
24/05/2017	p	Sprayed Cello in 200 lt/ha water volume	0.75	lt/ha
15/08/2017	a	Harvested	-	-

W Oats

14/09/2016	f	Applied TSP Fertilizer to all arable plots.	127.00	kg/ha
27/10/2016	s	Drilled Oats - Mascani trt Beret Gold - plots 17, 18, 21, 22, 51, 52, 63, 64	350.00	seeds/m^2
06/04/2017	f	Applied Nitram (34.5% N) Fertiliser - plots 17, 18, 21, 22, 51, 52, 63, 64	290.00	kg/ha
07/04/2017	f	Applied SOP (50% K2O, 45% SO3) - to all arable plots	150.00	kg/ha
22/05/2017	p	Sprayed Sprinter in 200 lt/ha water volume	2.00	lt/ha
22/05/2017	p	Sprayed Refin Max in 200 lt/ha water volume	75.00	g/ha
22/05/2017	p	Sprayed Cello in 200 lt/ha water volume	1.00	lt/ha
22/05/2017	p	Sprayed Hurler in 200 lt/ha water volume	0.75	lt/ha

15/08/2017		a	Harvested	-	-

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

Yields

LEYS

1ST CUT (27 JUN 2017) DRY MATTER TONNES/HECTARE

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

FYM_RES

LEY	NONE	FYM	MEAN
LC1	3.41	2.31	2.86
LC2	2.72	2.29	2.50
LC3	5.10	5.49	5.29
LN1	2.55	4.49	3.52
LN2	3.83	5.85	4.84
LN3	4.64	4.08	4.36
(LLC/LC)LC1	5.38	5.51	5.45
(LLC/LC)LC2	2.25	2.80	2.52
(LLC/LC)LC3	4.90	4.85	4.87
(LLN/LN)LN1	8.56	7.03	7.80
(LLN/LN)LN2	4.23	3.55	3.89
(LLN/LN)LN3	4.49	5.00	4.74
MEAN	4.34	4.44	0.39

1ST CUT MEAN DM% 0.30

2ND CUT (17 NOV 2017) DRY MATTER TONNES/HECTARE

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

FYM_RES

LEY	NONE	FYM	MEAN
LC1	0.35	0.68	0.51
LC2	0.76	0.67	0.71
LC3	1.18	1.99	1.58
LN1	0.74	1.10	0.92
LN2	0.95	1.02	0.98
LN3	4.15	1.40	2.77
(LLC/LC)LC1	1.06	1.72	1.39
(LLC/LC)LC2	0.45	0.34	0.39

(LLC/LC)LC3	2.20	2.93	2.56
(LLN/LN)LN1	2.84	2.28	2.56
(LLN/LN)LN2	0.95	0.91	0.93
(LLN/LN)LN3	1.24	1.16	1.20
MEAN	1.40	1.35	1.38

2ND CUT MEAN DM% 22.80

Total of 2 CUTS DRY MATTER TONNES/HECTARE

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

FYM_RES			
LEY	NONE	FYM	MEAN
LC1	3.76	2.99	3.37
LC2	3.48	2.95	3.22
LC3	6.28	7.48	6.88
LN1	3.28	5.59	4.44
LN2	4.77	6.86	5.82
LN3	8.79	5.48	7.13
(LLC/LC)LC1	6.44	7.22	6.83
(LLC/LC)LC2	2.69	3.14	2.91
(LLC/LC)LC3	7.10	7.77	7.44
(LLN/LN)LN1	11.40	9.32	10.36
(LLN/LN)LN2	5.18	4.47	4.82
(LLN/LN)LN3	5.73	6.15	5.94
MEAN	5.74	5.79	5.76

2ND CUT MEAN DM% 33.10

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.

ARABLE TREATMENT CROPS

WINTER BEANS

GRAIN (85% DRY MATTER) TONNES/HECTARE

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

FYMRES ROTATION	NONE	FYM	Mean
(AO)Be	0.34	1.01	0.68
(LLn/AO)Be	0.75	1.26	1.01
(LLc/ABe)Be	2.31	1.20	1.76
(ABe)Be	1.78	2.19	1.99
Mean	1.30	1.42	1.36

Grain mean DM%	85.3
Plot area harvested	0.00393

RYE (EXTRA)

GRAIN (85% DRY MATTER) TONNES/HECTARE

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

FYMRES ROTATION	NONE	FYM	Mean
(AO)Be	5.91	5.18	5.54
(LLn/AO)Be	5.62	5.28	5.45
(LLc/ABe)Be	5.07	5.84	5.46
(ABe)Be	6.33	5.76	6.05
Mean	5.73	5.52	5.62

Grain mean DM%	86.1
Plot area harvested	0.00393

WINTER WHEAT

Grain tonnes/hectare

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

FYMRES ROTATION	none	FYM	Mean
(AO)W	5.95	5.33	5.64
(ABe)W	4.82	4.45	4.63
(LLn/AO)W	5.24	4.80	5.02
(LLc/ABe)W	6.24	7.37	6.80
(LN)W	4.70	5.26	4.98
(LLN/Ln)W	5.74	5.93	5.84
(LC)W	7.54	6.36	6.95
(LLc/Lc)W	7.35	6.88	7.11
Mean	5.95	5.80	5.87

N ROTATION	0	80	160	240	Mean
(AO)W	2.63	5.18	7.08	7.67	5.64
(ABe)W	3.00	5.20	5.03	5.30	4.63
(LLn/AO)W	2.77	6.46	6.83	4.02	5.02
(LLc/ABe)W	5.89	7.77	7.48	6.08	6.8
(LN)W	4.28	5.29	6.00	4.35	4.98
(LLN/Ln)W	3.33	6.61	6.38	7.03	5.84
(LC)W	5.71	8.07	7.71	6.30	6.95
(LLc/Lc)W	5.89	7.40	7.31	7.85	7.11
Mean	4.19	6.50	6.73	6.07	5.87

N FYMRES	0	80	160	240	Mean
none	4.06	6.50	7.12	6.10	5.95
FYM	4.31	6.49	6.34	6.04	5.80
Mean	4.19	6.50	6.73	6.07	5.87

ROTATION	N FYMRES	0	80	160	240
(AO)W	none	2.71	5.6	7.77	7.71
	FYM	2.55	4.75	6.39	7.62
(ABe)W	none	2.42	4.63	7.17	5.04
	FYM	3.57	5.77	2.89	5.55
(LLn/AO)W	none	2.59	6.79	6.64	4.95
	FYM	2.96	6.13	7.01	3.09
(LLc/ABe)W	none	6.09	7.98	5.68	5.20
	FYM	5.69	7.55	9.29	6.96
(LN)W	none	3.75	5.05	6.39	3.61
	FYM	4.81	5.53	5.61	5.08
(LLN/Ln)W	none	3.47	6.42	6.72	6.35

	FYM	3.19	6.79	6.04	7.71
(LC)W	none	5.81	7.58	8.97	7.80
	FYM	5.62	8.56	6.46	4.79
(LLc/Lc)W	none	5.67	7.92	7.62	8.18
	FYM	6.11	6.87	7.00	7.53

Grain mean DM%	86.9
Plot area harvested	0.00183

WINTER RYE

Grain tonnes/hectare

Tables of means

FYMRES	none	FYM	Mean
ROTATION			
(AO)R	5.16	6.06	5.61
(ABe)R	6.07	7.01	6.54
(LLn/AO)R	5.76	6.49	6.13
(LLc/ABe)R	6.81	6.96	6.89
(Ln)R	7.16	6.59	6.87
(LLn/Ln)R	6.15	6.99	6.57
(Lc)R	6.61	6.88	6.74
(LLc/Lc)R	7.00	7.11	7.06
Mean	6.34	6.76	6.55

N	0	50	100	150	Mean
ROTATION					
(AO)R	2.84	5.07	7.18	7.36	5.61
(ABe)R	3.61	6.64	7.68	8.24	6.54
(LLn/AO)R	3.37	6.64	7.41	7.08	6.13
(LLc/ABe)R	4.57	6.72	7.88	8.39	6.89
(Ln)R	5.17	6.97	7.22	8.14	6.87
(LLn/Ln)R	4.75	7.02	7.30	7.22	6.57
(Lc)R	5.48	6.25	7.47	7.78	6.74
(LLc/Lc)R	5.19	7.39	8.34	7.31	7.06
Mean	4.37	6.59	7.56	7.69	6.55

N	0	50	100	150	Mean
FYMRES					
none	4.22	6.49	7.45	7.2	6.34
FYM	4.52	6.69	7.67	8.17	6.76
Mean	4.37	6.59	7.56	7.69	6.55

N	0	50	100	150

ROTATION	FYMRES				
(AO)R	none	2.38	4.65	7.25	6.37
	FYM	3.30	5.50	7.11	8.35
(ABe)R	none	3.25	6.46	6.87	7.72
	FYM	3.97	6.82	8.49	8.76
(LLn/AO)R	none	2.97	6.37	7.33	6.38
	FYM	3.78	6.91	7.49	7.78
(LLc/ABe)R	none	3.73	6.83	8.48	8.21
	FYM	5.40	6.62	7.27	8.57
(Ln)R	none	6.32	7.15	7.17	8.02
	FYM	4.02	6.79	7.27	8.27
(LLn/Ln)R	none	4.41	7.05	6.34	6.78
	FYM	5.08	6.98	8.26	7.65
(Lc)R	none	5.55	6.04	7.81	7.02
	FYM	5.41	6.45	7.12	8.54
(LLc/Lc)R	none	5.16	7.34	8.37	7.14
	FYM	5.23	7.43	8.31	7.48

Grain mean DM%	86.73
Plot area harvested	0.00183

WINTER OATS

GRAIN (85% DRY MATTER) TONNES/HECTARE

Tables of means

FYMRES	NONE	FYM	Mean
ROTATION			
ABe	1.02	1.15	1.09
AO	3.81	3.36	3.59
LLc/ABe	1.59	1.54	1.56
LLn/AO	2.41	2.78	2.59
Mean	2.21	2.21	2.21

Grain mean DM%	80.9
Plot area harvested	0.00393

17/W/RN/12 ORGANIC MANURING (Stackyard B, Woburn Farm)

Object: To study, from crop yields and soil analyses, the effects of a range of types of organic matter – Woburn, Stackyard B.

Sponsors: A. J. Macdonald

The 52nd year, Forage Maize.

For previous years see 'Details' 1973 and Yield Books for 74-16/W/RN/12.

Design: 4 blocks of 8 plots

Whole plot dimensions: 8.0 m x 29.5 m (8.0 m x 26.5 m on Block III).

Treatments: From 1966 to 1971 the experiment had a preliminary period designed to build up organic matter from different sources. An arable rotation was started on two blocks on 1972 and the remaining two blocks in 1973. After a period of testing the residues, a further period of accumulation was started; on two blocks (which included ley sown in 1979) in 1981 and on the other two (which included ley sown in 1980) in 1982. A second test phase began when leys on the first pair of blocks were ploughed for the 1st test crop in 1987 and on the second pair for the 1st test crop in 1988. From 1988 two blocks, and 1989 the other two, to 1994, plots were split into 6 sub-plots to test five levels of nitrogen and nil. From 1995 to 1997 residual effects of that nitrogen were measured. In 1998 to 2000 yields were taken from whole plots only. In 2001 plots were split into half-plots to test two rates of N.

For 2003 the experiment was modified to test further inputs of organic matter. An arable rotation (winter rye, spring barley, winter beans, winter wheat, forage maize) was started on seven plots within each block; the eighth was sown to a grass/clover ley.

Whole plots

1. **Treatment** (Not necessarily applied each year):

1966-1971/2	1979/82-1986/7	Since 2003
Fd	Fd	F
Ln	Lc6	F
St	St	St
Gm	Lc8	CC
Pt	Lc8	Co
Fs	Fs	Dg10
Dg	Dg	Dg25
Lc	Lc6	Lc

F: no organic amendment. St: chopped straw at 7.5t/ha. CC: cover crop prior to spring sown crops. Co: compost at 40t/ha. Dg10: FYM at 10t/ha. Dg25: FYM at 25t/ha. Dg: FYM at 50t/ha. Fd: fertilizers equivalent to FYM. Fs: fertilizers equivalent to straw (+P). Lc/Lc6/Lc8: grass/clover leys. Ln: grass ley + N. Gm: green manure. Pt: peat.

Since 2003, all treatments, except Dg25, have also received PKS fertilizers:

20 kg P/ha, 83 kg K/ha, 36 kg S/ha

In addition, in 2003 F and CC treatments received 120 kg N/ha, St received 90 kg N/ha. Dg10 received 60 kg N/ha. No N was applied to Dg25, Co or Lc treatments.

Nitrogen

In 2008 all plots, except Lc (permanent grass/clover), split into 6 to test rates of N. For crops receiving nitrogen rates rotate as follows:

N0 > N1 > N2 > N3 > N4 > N5 > N0 etc.

For 2009 spring barley crop nitrogen rates (kg N/ha) were:

0, 35, 70, 105, 140, 175 as nitro-chalk (27% N).

No N was applied to the beans in 2010

For 2011 Winter wheat rates were 0, 50, 100, 150, 200 & 250 kg N/ha as nitro-chalk (27% N).

For 2012 Forage maize rates were 0, 50, 100, 150, 200, 250 & 250 kg N/ha as Nitro-chalk (27% N)

For 2013 Winter rye nitrogen rates were 0, 30, 60, 90, 120 & 150 kg N/ha as Nitro-chalk (27% N)

For 2014 S Barley nitrogen rates were 0, 35, 70, 105, 140 & 175 kg N/ha as Nitro-chalk (27% N)

For 2015 Winter beans – No Nitrogen Applied

For 2016 Winter wheat rates were 0, 50, 100, 150, 200 & 250 kg N/ha as Nitro-Chalk (27% N)

For 2017 Forage maize rates were 0, 50, 100, 150, 200 & 250 kg N/ha as Nitro-Chalk (27% N)

Experimental Diary

Date		Application	Rate	Units
09/09/2016	s	Hand broadcast mustard Zlata - plots 4, 10, 19 and 32 only. Cover Crop plots (CC).	10.00	kg/ha
09/09/2016	a	Power harrowed - Cover crop plots lightly.	-	-
13/04/2017	p	Sprayed Firebrand - Sprayed off stubble only.	1.00	lt/ha
13/04/2017	p	Sprayed Samurai - Sprayed off stubble only.	4.00	lt/ha
20/04/2017	f	Applied Chalk - all plots	5.00	t/ha
21/04/2017	f	Applied SOP (50% K2O, 45% SO3) - all plots apart from 5, 11, 23, 26.	200.00	kg/ha
21/04/2017	f	Applied MOP - all plots a part from 5,11,23,26.	97.50	kg/ha
24/04/2017	f	Applied compost - plots 7, 12, 21, 27	40.00	t/ha
25/04/2017	f	Applied straw - plots 3, 15, 17, 31	7.50	t/ha
25/04/2017	f	Applied FYM - plots 5, 11, 23, 26	25.00	t/ha
25/04/2017	f	Applied FYM - plots 8, 14, 18, 28	10.00	t/ha
26/04/2017	a	Topped straw plots	-	-
27/04/2017	a	Ploughed - thrown south east	-	-
03/05/2017	a	Power harrowed	-	-
04/05/2017	a	Rolled prior to drilling	-	-
04/05/2017	s	Drilled maize Severus tr. Mesurial	10.10	s/m^2
25/05/2017	f	Applied Nitro-chalk (27% N) by hand - N1 to N5 treatments	185.00	kg/ha
19/06/2017	a	Cut paths	-	-
22/06/2017	f	Applied Nitro-chalk (27% N) by hand. To plots 0025, 0033, 0044, 0054, 0064, 0076, 0085, 0091, 0102, 0111, 0123, 0142, 0154, 0162, 0176, 0181, 0192, 0201, 0211, 0223, 0236, 0252, 0262, 0273, 0283, 0305, 0312, 0323 - Maize plots only	185.00	kg/ha

22/06/2017	f	Applied Nitro-chalk (27% N) by hand. To plots 0023, 0034, 0042, 0051, 0061, 0074, 0086, 0094, 0103, 0114, 0125, 0141, 0152, 0165, 0172, 0183, 0191, 0204, 0216, 0221, 0234, 0254, 0264, 0275, 0281, 0306, 0316, 0321 - Maize plots only	370.00	kg/ha
22/06/2017	f	Applied Nitro-chalk (27% N) by hand. To plots 0026, 0031, 0041, 0052, 0066, 0075, 0081, 0096, 0101, 0115, 0122, 0145, 0151, 0161, 0174, 0184, 0196, 0203, 0213, 0224, 0233, 0251, 0261, 0276, 0285, 0301, 0314, 0322 - Maize plots only	556.00	kg/ha
22/06/2017	f	Applied Nitro-chalk (27% N) by hand. To plots 0024, 0032, 0045, 0053, 0065, 0073, 0084, 0093, 0106, 0116, 0126, 0146, 0155, 0163, 0171, 0185, 0193, 0202, 0215, 0226, 0235, 0256, 0266, 0272, 0282, 0304, 0311, 0325 - Maize plots only	741.00	kg/ha
26/06/2017	p	Sprayed Callisto in 200 lt/ha water volume - maize plots only	1.50	lt/ha
26/06/2017	p	Sprayed Samson Extra in 200 lt/ha water volume	0.75	lt/ha
27/06/2017	a	Cut grass plots for yield (1st Cut)	-	-
06/07/2017	a	Mowed all remaining grass on plots	-	-
10/07/2017	a	Baled and removed all remaining grass	-	-
11/08/2017	a	Topped Surrounds and paths	-	-
20/09/2017	a	Started Harvesting Maize for Yield	-	-
21/09/2017	a	Finished Harvesting Maize for Yield	-	-
29/09/2017	a	Topped Trial Site	-	-
17/11/2017	a	Cut grass plots for yield (2nd Cut)	-	-

Yields

FORAGE MAIZE

GRAIN TONNES/HECTARE (100% DM)

Tables of means

Nitrogen	0	50	100	150	200	250	Mean
Treatment							
F(Fd)	3.40	6.04	7.05	8.85	10.37	10.06	7.63
F(Ln, Lc6)	5.31	8.27	9.57	11.87	10.62	13.05	9.78
St(St)	5.75	6.79	8.88	9.26	10.84	12.14	8.94
CC(Gm, Lc8)	5.19	5.59	8.93	8.61	7.51	11.64	7.91
Co(Pt, Lc8)	7.96	11.38	13.86	11.60	13.13	13.91	11.97
Dg10(Fs)	6.32	8.14	11.70	11.57	12.78	12.86	10.56
Dg25(Dg)	9.75	13.24	16.00	13.45	13.94	14.79	13.53
Mean	6.24	8.49	10.85	10.74	11.31	12.64	10.05

Standard errors of differences of means

Table	Treatment	Nitrogen	Treatment Nitrogen
s.e.d.	1.559	0.499	1.971
Except when comparing means with the same level(s) of Treatment	1.321		
d.f.	105		
Grain Mean DM (%)	28.8		
Plot area harvested (ha)	0.00063		

GRASS/CLOVER

DRY MATTER TONNES/HECTARE
***** Table of means *****

Year	1st Cut	2nd Cut	Total
2003	-	-	-
2004	1.82	-	1.82
2005	1.86	0.13	1.99
2006	4.07	-	4.07
2007	3.12	1.36	4.48
2008	5.72	1.65	7.37
2009	4.77	-	4.77
2010	4.41	-	4.41
2011	1.46	0.39	1.85
2012	4.11	0.64	4.75
2013	4.65	0.60	5.24
2014	4.09	0.91	5.01
2015	*	0.36	-
2016	3.97	0.56	4.54
2017	2.17	1.48	3.65

Cut dry matter t/ha (27 JUN 2017 & 17 NOV 2017)

Note: Whole maize crop and herbage samples were taken for chemical analyses and archiving.

17/R/CS/326 and 17/W/CS/326 AMOUNTS OF STRAW

(Gt. Knott III (R) and Far field I (W))

Object: To study the effects of different amounts of straw, incorporated into the soil, on winter wheat – Rothamsted (R) Great Knott III, Woburn (W) Far Field I

Sponsors: A Macdonald and M. J. Glendining,

The 31st year, winter wheat (no yields taken).

Notes: Both experiments will finish in autumn 2017. No yields to be taken in 2016 or 2017. Only farm diary details are shown below. For previous years see Yield Books for 87-17/R & W/CS/326.

Design: 4 randomised blocks of 4 plots (R)

3 randomised blocks of 4 plots (W)

Whole plot dimensions:

3.0 m x 13.5 m (R) = 0.0040 ha

3.0 m x 14.5 m (W) = 0.0043 ha

Treatments:

Amounts of straw incorporated into the seedbed (t/ha), cumulative to previous annual dressings:

		R	W
NONE	None	-	-
NORMAL	Normal	4.70	3.39
2 NORMAL	Twice normal	9.40	6.78
4 NORMAL	Four times normal	18.80	13.56

Experimental Diary

Great Knott III (R)

Date		Application	Rate	Units
21/09/2016	a	Loaded Straw onto Plots 4, 7, 11, 14	4.70	t/ha
21/09/2016	a	Loaded Straw onto Plots 2, 6, 10, 13	9.40	t/ha
21/09/2016	a	Loaded Straw onto Plots 3, 5, 9, 16	18.80	t/ha
21/09/2016	a	Topped Straw before Ploughing	-	-
22/09/2016	a	Sub-Soiled Tramlines	-	-
23/09/2016	a	Ploughed - thrown East	-	-
07/10/2016	a	Ring Rolled - all new drilling	-	-
13/10/2016	p	Sprayed Liberator	600.00	ml/ha

13/10/2016	p	Sprayed Jade	3.00	lt/ha
13/10/2016	p	Sprayed Deploy	400.00	ml/ha
08/11/2016	p	Applied Major Slug Pellets	5.00	kg/ha
30/11/2016	p	Sprayed Hallmark	50.00	ml/ha
09/03/2017	f	Applied Doubletop	148.00	kg/ha
27/03/2017	p	Sprayed Chex - winter wheat only	250.00	ml/ha
27/03/2017	p	Sprayed Pacifica - winter wheat only	500.00	0g/ha
27/03/2017	p	Sprayed Bio Power - winter wheat only	1.00	lt/ha
04/04/2017	f	Applied Nitram (34.5% N) - winter wheat only	260.00	kg/ha
05/04/2017	p	Sprayed Artemis	1.00	lt/ha
05/04/2017	p	Sprayed Claw 500	1.00	lt/ha
05/04/2017	p	Sprayed3C Chlormequat 750	2.00	lt/ha
23/04/2017	p	Sprayed Keystone	600.00	ml/ha
23/04/2017	p	Sprayed Epic	400.00	ml/ha
23/04/2017	p	Sprayed Balear 720	700.00	ml/ha
04/05/2017	f	Applied Nitram to WW	260.00	kg/ha
13/06/2017	p	Sprayed Fezan (Tebuconazole)	750.00	ml/ha
15/08/2017	a	Harvested as a commercial crop	-	-

Far Field I (W)

Date		Application	Rate	Unit
02/09/2016	a	Straw loaded to plots 18, 24, 26	3.40	t/ha
02/09/2016	a	Straw loaded to plots 17, 22, 25	6.80	t/ha
02/09/2016	a	Straw loaded to plots 20, 23, 27	13.60	t/ha
02/09/2016	a	Topped straw to help ploughing	-	-
05/09/2016	a	Ploughed - thrown north west	-	-
26/09/2016	a	Power harrowed	-	-
04/10/2016	s	Drilled Crusoe tr Redigo Pro + Deter	375.00	seeds/m^2
04/10/2016	a	Rolled	-	-
25/10/2016	p	Sprayed Hallmark in 200 lt/ha water volume.	50.00	ml/ha

25/10/2016	p	Sprayed Movon in 200 lt/ha water volume.	1.00	lt/ha
08/03/2017	f	Applied Double Top Fertilizer	148.00	kg/ha
27/03/2017	a	Sprayed Chex	0.25	lt/ha
27/03/2017	a	Sprayed Pacifica	0.50	kg/ha
27/03/2017	a	Sprayed Cogent	2.00	lt/ha
07/04/2017	a	Sprayed Sprinter in 150 lt/ha water volume	2.00	lt/ha
07/04/2017	a	Sprayed Artemis in 150 lt/ha water volume	1.00	lt/ha
07/04/2017	a	Sprayed Claw 500 in 150 lt/ha water volume	1.00	lt/ha
07/04/2017	a	Sprayed Moddus in 150 lt/ha water volume	0.10	lt/ha
07/04/2017	a	Sprayed Chlormequat in 150 lt/ha water volume	1.00	lt/ha
10/04/2017	f	Applied Nitram (34.5% N) Fertiliser	203.00	kg/ha
25/04/2017	f	Applied Nitram (34.5% N) Fertiliser	203.00	kg/ha
28/04/2017	p	Sprayed Sprinter in 150 lt/ha water volume	2.00	lt/ha
28/04/2017	p	Sprayed Keystone in 150 lt/ha water volume	0.80	lt/ha
28/04/2017	p	Sprayed Balear 720 in 150 lt/ha water volume	0.70	lt/ha
24/05/2017	p	Sprayed Sprinter in 150 lt/ha water volume	2.00	t/ha
24/05/2017	p	Sprayed Vortex in 150 lt/ha water volume	1.50	lt/ha
13/08/2017	a	Harvested as a commercial crop	-	-

Weather Summaries

Rothamsted Research															
The Weather : Monthly Summary : 2017															
(Departure from the 30 year means (1981 - 2010) in brackets)															
	Sunshine		**Mean temperatures °C**								**Rain**		**Rain**	**Drainage**	**Wind**
			Maximum		**Minimum**		**Dew point**	**Ground**	**In ground under grass**		**Tipping Bucket**			**20"**	
	Hours	( )	**°C**	( )	**°C**	( )	**°C**	**frosts***	**30 cm**	**100 cm**	**Total mm**	( )	**days****	**mm**	**km/hr*****
January	77.2	(+15.19)	6.3	(-0.38)	-0.2	(-1.40)	1.52	19	4.1	6.8	70.2	(+0.21)	23	49.6	6.2
February	62.8	(-17.48)	8.5	(+1.59)	3.2	(+2.29)	4.52	15	5.6	6.3	38.7	(-11.40)	18	19.0	10.1
March	139.9	(+24.97)	12.7	(+2.76)	5.0	(+2.33)	6.64	15	8.0	7.8	40.4	(-10.42)	21	13.1	9.9
April	197.4	(+36.17)	13.8	(+1.20)	4.2	(+0.13)	4.95	17	10.2	9.6	10.9	(-44.19)	14	0.1	7.1
May	185.1	(-9.57)	17.7	(+1.65)	8.7	(+1.79)	10.23	2	12.7	11.0	70.5	(+15.82)	16	19.8	7.3
June	229.1	(+30.91)	21.5	(+2.38)	12.0	(+2.25)	12.21	1	16.7	14.3	39.1	(-14.12)	12	4.2	7.9
July	187.4	(-17.77)	21.8	(+0.00)	13.2	(+1.31)	12.74	0	17.6	15.9	72.6	(+22.69)	16	7.5	7.2
August	170.2	(-26.04)	20.2	(-1.39)	11.8	(-0.03)	13.3	0	16.7	15.9	66.6	(+2.89)	14	16.0	6.8
September	116.9	(-26.44)	17.3	(-0.94)	9.8	(-0.17)	11.4	1	15.0	15.1	86.9	(+29.29)	23	23.7	6.7
October	87.4	(-24.30)	15.4	(+1.37)	9.1	(+1.99)	10.3	3	13.5	13.9	31.2	(-50.51)	19	5.8	8.9
November	92.0	(+21.21)	9.6	(-0.09)	3.5	(-0.28)	4.8	15	9.4	11.3	53.5	(-23.09)	22	18.2	8.4
December	57.4	(+3.57)	7.2	(+0.35)	1.8	(+0.17)	3.1	19	6.0	8.1	110.8	(+41.25)	24	98.4	10.0
Year	1602.7	(+10.41)	14.3	(+0.71)	6.8	(+0.86)	8.0	107.0	11.3	11.3	691.4	(-41.58)	222.0	275.4	8.1
* Number of nights grass minimum was below 0.0 °C															
** Number of days rain was 0.2 mm or more															
*** At 2 metres above the ground															

Woburn Experimental Farm

The Weather : Monthly Summary : 2017

(Departure from 30-year means (1981 - 2010) in brackets)

	Sunshine		Mean temperatures °C								Rain			Wind
			Maximum		Minimum		Dew	Ground	In ground under grass		Total mm		Rain	***
	Hours	( )		( )		( )	point	frosts *	30 cm	100 cm	Tipping bucket		days **	km/hr
												( )		
January	66.7	(+6.63)	6.7	(-0.30)	-0.4	(-1.62)	1.6	19	3.9	7.4	67.0	(+12.46)	20	5.7
February	64.7	(-10.18)	9.1	(+1.73)	3.2	(+2.32)	4.8	15	5.9	6.6	47.3	(+5.09)	19	9.7
March	144.6	(+31.10)	13.0	(+2.69)	4.9	(+2.22)	6.8	16	8.3	7.8	48.1	(+2.18)	18	9.5
April	183.8	(+32.85)	14.3	(+1.21)	3.6	(-0.20)	5.3	17	10.3	9.4	13.4	(-38.77)	14	7.0
May	186.3	(-0.89)	18.3	(+1.78)	8.2	(+1.65)	10.3	3	13.8	10.9	71.6	(+18.35)	14	7.2
June	221.3	(+33.41)	22.1	(+2.55)	11.7	(+2.31)	12.4	0	18.0	14.2	40.3	(-9.75)	12	9.1
July	184.6	(-12.49)	22.4	(+0.32)	12.6	(+0.96)	13.1	0	18.6	15.9	97.6	(+47.71)	17	7.7
August	176.5	(-12.30)	20.8	(-1.09)	11.3	(-0.27)	13.2	0	17.7	16.1	76.8	(+18.98)	15	7.0
September	119.7	(-17.37)	17.9	(-0.75)	9.4	(-0.20)	12.9	1	15.6	15.6	73.4	(+16.29)	25	6.8
October	89.7	(-22.06)	16.0	(+1.57)	9.1	(+2.19)	11.5	4	13.8	14.5	33.2	(-37.63)	14	10.0
November	77.1	(+10.89)	10.1	(+0.17)	3.2	(-0.59)	6.0	13	9.1	12.1	51.2	(-11.27)	18	8.5
December	45.9	(+0.24)	7.6	(+0.38)	1.9	(+0.44)	4.0	19	5.8	9.1	76.6	(+20.85)	21	10.2
Year	1560.9	(+39.83)	15.0	(+0.86)	6.6	(+0.78)	8.6	107.0	11.8	11.7	696.5	(+44.48)	207.0	8.3
* Number of nights grass minimum was below 0.0 °C														
** Number of days rain was 0.2 mm or more														
*** At 2 metres above ground														