ROTHAMSTED
RESEARCH

Results of the

Classical and other

Long-term Experiments

2018

Contents

Conventions i
18/R/BK/1 BROADBALK 1
18/R/HB/2 HOOS BARLEY (Hoosfield) 12
18/R/WF/3 WHEAT AND FALLOW (Hoosfield) 18
18/R/EX/4 EXHAUSTION LAND (Hoosfield) 19
18/R/PG/5 PARK GRASS 23
18/R/GC/8 GARDEN CLOVER (Manor Garden) 30
18/W/RN/3 LEY/ARABLE (Stackyard D, Woburn Farm) 31
18/W/RN/12 ORGANIC MANURING (Stackyard B, Woburn Farm) 43
Weather Summaries (Rothamsted & Woburn) 48

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
3C Chlormequat 750	gr	chlormequat (750 g/l)
Adigor	wetter	47% w/w methylated rapeseed oil
Ally Max SX	h	metsulfuron-methyl + tribenuron-methyl (14.3:14.3 % w/w)
Aphox	i	pirimicarb (50% w/w)
Artemis	f	fenpropidin + prochloraz + tebuconazole (250:200:100 g/l)
Atlantis	h	iodosulfuron-methyl-sodium + mesosulfuron-methyl (0.6:3.0 % w/w)
Aviator 235 Xpro	f	bixafen + prothioconazole (75:160g/l)
Axial	h	pinoxaden (100 g/l)
Balear 720 SC	f	chlorothalonil (720 g/l)
Bassoon EC	f	epoxiconazole (83 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	water conditioner	ammonium sulphate (40 % w/w)
Callisto	h	mesotrione (100 g/l)
Cello	f	prothioconazole + spiroxamine + tebuconazole (100:250:100 g/l)
Cintac	h	iodosulfuron-methyl-sodium + mesosulfuron-methyl (1.0:3.0% w/w)
Chex	water conditioner	A soluble liquid concentrate containing water conditioning and acidifying agents, humectant, pH buffer and an anti-foam.
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)
Crawler	h	carbetamide (60% w/w)
Cyflamid	f	cyflufenamid (50 g/l)
Defy	h	prosulfocarb (800 g/l)
Deploy 1000	ad	alcohol alkoxylate (1000 g/l)
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)
Firestorm	h	diflufenican + flufenacet (100:400 g/l)
Folicur	f	tebuconazole (250 g/l)
Hallmark with zeon tech	i	lambda-cyhalothrin (100 g/l)
Hatchet xtra	h	fluroxypyr (200 g/l)

Hiatus	h	thifensulfuron-methyl + tribenuron-methyl (40:15% w/w)
Hurler	h	fluroxypyr (200 g/l)
Hurricane SC	h	diflufenican (500 g/l)
Jade	h	prosulfocarb 800 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
Lexus SX	h	flupyrsulfuron-methyl (500g/kg)
Mesurol	i	methiocarb (500g/l), seed dressing
Moddus	gr	trinexapac-ethyl (250 g/l)

Machinery Referred to in the Diary Notes

Cultivators	Manufacturer	Width	Description
Plough	Kverneland	1.5 m	5 Furrow, 25 cm Furrows.
Plough	Ransome	1m	3 Furrow, 25cm Furrows
Press	Philip Watkins	4.6m	Used to level and consolidate grond 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.

Chemical Applications	Manufacturer	Width	Description
Cascade	Horstine	12 m	Tractor mounted pnuematic boom fertiliser spreader
Litetrac Spreader	Litetrac	12m	Tractor mounted pnuematic boom fertiliser spreader - used for 2018 fertiliser spreading only
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 Applications.
Lowspread	Lowspread	2.76 m	Tractor Mounted - Fert Applications.

Harvesters	**Manufacturer**	**Width**	**Description**
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	Flexicoil	6m	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 in the experimental diary.

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

18/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. In 2018 (175th year) winter beans (Be) replaced maize on the rotational sections and the rotation was changed to wheat, wheat, oats, wheat, beans. The new rotation includes two first wheats each year. Previously, only one first wheat was included in the rotation. This change has resulted in additional harvest sampling and analysis, to include both first wheats and the beans.

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 74-17/R/BK/1.

Areas harvested [a]:

	Section	
Wheat:	0	0.00305
	1	0.00561
	2,3,5 and 6	0.00463
	8, 9	0.00488
Oats:	4	0.00463
Beans:	7	0.00453

[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.

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 wheat – single N to wheat
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.

Winter oats – single N application
½ N1, ½ N2, ½ N3, ½ N4, ½ N5, ½ N6: 24, 48, 72, 96, 120, 144 kg N as 33.5%N; applied at half the rate for wheat in a single application in mid-April; FYM applied at 35t/ha (fresh wt). Oats received no N or FYM from 1996 to 2017.

Winter Beans (Be) Non N or FYM applied.

All crops P, K, Mg & FYM applications as shown below:-
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

Section	1	9	0*	8+	6**	5	3	7	4	2
Year										
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
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
2018	W	W	W	W	W	W	W	Be	O	W

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

(6) In 2018 winter beans (Be) replaced maize on the rotational sections to give a five year rotation of wheat, wheat, oats, wheat, beans. Details of changes to N fertilizer and FYM applications are given on p2.

18/R/BK/1 Experimental Diary:

Date		Application	Rate	Units
All Sections				
20/09/2017	f	Applied MOP to Strip 14, All Sections	181	kg/ha
20/09/2017	f	Applied TSP to Strips 11, 13, 14, 17 and 18, All Sections	171	kg/ha
21/09/2017	a	Ring Rolled all Field	-	-
22/09/2017	f	Applied FYM to Strips 2.20 + 2.10	35	t/ha
22/09/2017	p	Sprayed Buffalo Elite onto all section BUT NOT section 8	1.00	lt/ha
22/09/2017	p	Sprayed Buffalo Samurai onto all section BUT NOT section 8	5.00	lt/ha
27/09/2017	a	Ploughing - Thrown North	-	-
03/10/2017	a	Cultipressed	-	-
09/10/2017	a	Flexicoil Rolled - pre-drilling	-	-
09/10/2017	a	Ring Rolled	-	-
24/04/2018	f	Applied Kiserite onto strips 20, 19, 18, 17, 16, 15, 12, 11, 9, 8, 7, 6 + 5	80.00	kg/ha

25/04/2018	f	Applied SOP onto strips 20, 19, 18, 17, 16, 15, 13, 12, 9, 8, 7, 6 + 5	217.00	kg/ha
16/05/2018	a	Flexitined fallow areas only	-	-
16/05/2018	a	Rotared fallow areas only	-	-
04/07/2018	a	cut paths either side of section 8	-	-
12/07/2018	a	pulled wild oats - 2 on plot 164 - 1 on plot 108	-	-
22/08/2018	a	Harvested Plots Sides to open up for baling	-	-
28/08/2018	a	Completed Straw Weights on sections 1, 2, 3, 7 + 8	-	-
01/09/2018	a	Baled All Swaths	-	-

W Wheat

09/10/2017	s	Drilled Crusoe trt Beret Gold - Sections 0, 1, 2, 3, 5, 6, 8 + 9	350.00	seeds/m2
16/10/2017	p	Sprayed Pontos - Sections 0, 1, 2, 3, 5, 6 + 9 - Accidental Spraying of Section 8. East End Half of plot 148	1.00	lt/ha
16/10/2017	p	Sprayed Jade - Sections 0, 1, 2, 3, 5, 6 + 9 - Accidental Spraying of Section 8. East End Half of plot 148	3.00	lt/ha
16/10/2017	p	Sprayed Velomax - Sections 0, 1, 2, 3, 5, 6 + 9 - Accidental Spraying of Section 8. East End Half of plot 148	400.00	lt/ha
19/04/2018	f	Applied 1st Split Nitram @ 34.5%N - to strips 19, 18, 17 + 12 excluding Sections 4 and 7	139.00	kg/ha
19/04/2018	f	Applied 2nd Split Nitram @ 34.5%N - to strips 6 and 19 excluding Sections 4 and 7	139.00	kg/ha
19/04/2018	f	Applied 2nd Split Nitram @ 34.5%N - to strips 7 and 18 excluding Sections 4 and 7	278.00	kg/ha
19/04/2018	f	Applied 2nd Split Nitram @ 34.5%N - to strips 2.1, 8 and 12 excluding Sections 4 and 7 and plot 2.10	417.00	kg/ha
19/04/2018	f	Applied 2nd Split Nitram @ 34.5%N - to strips 9, 10, 11, 13, 14 and 17 excluding Sections 4 and 7	556.00	kg/ha
19/04/2018	f	Applied 2nd Split Nitram @ 34.5%N - to strips 15 excluding Sections 4 and 7	696.00	kg/ha
19/04/2018	f	Applied 2nd Split Nitram @ 34.5%N - to strips 16 excluding Sections 4 and 7	835.00	kg/ha
20/04/2018	f	Applied 2nd Split Nitram @ 34.5%N - to plot 2.10 only	417.00	kg/ha
03/05/2018	p	Sprayed Artemis onto sections 0 1 2 3 5 8 + 9	1.00	lt/ha
03/05/2018	p	Sprayed Keystone onto sections 0 1 2 3 5 8 + 9	800.00	ml/ha

03/05/2018	p	Sprayed Balear720SC onto sections 0 1 2 3 5 8 + 9	700.00	ml/ha
03/05/2018	p	Sprayed Moddus onto sections 0 1 2 3 5 8 + 9	1.25	lt/ha
03/05/2018	p	Sprayed Stefes CCC 720 Chlormequat onto sections 0 1 2 3 5 8 + 9	150.00	ml/ha
03/05/2018	f	Applied Nitram @ 34.5%N - to strips 19, 18, 17 + 12 excluding Sections 4 and 7	139.00	kg/ha
08/08/2018	a	Harvested All Wheat Plots For Yield	-	-
28/08/2018	a	Completed Straw Weights on sections 1, 2, 3, + 8	-	-

W Oats

09/10/2017	s	Drilled Miscani trt Beret Gold - Section 4 only	350.00	seeds/m2
17/11/2017	p	Sprayed Hallmark - Section 4	50.00	ml/ha
17/11/2017	p	Sprayed Lexus - Section 4	10.00	gms/ha
17/11/2017	p	Sprayed Hurricane - Section 4	100.00	ml/ha
17/11/2017	p	Sprayed Velomax - Section 4	400.00	ml/ha
31/05/2018	f	Applied Nitram @ 34.5%N - Section 4 only	35.00	kg/ha
31/05/2018	f	Applied Nitram @ 34.5%N - Section 4 only	69.50	kg/ha
31/05/2018	f	Applied Nitram @ 34.5%N - Section 4 only	104.50	kg/ha
31/05/2018	f	Applied Nitram @ 34.5%N - Section 4 only	139.00	kg/ha
31/05/2018	f	Applied Nitram @ 34.5%N - Section 4 only	174.00	kg/ha
31/05/2018	f	Applied Nitram @ 34.5%N - Section 4 only	208.50	kg/ha
26/07/2018	a	completed straw weights - Section 4 only	-	-
26/09/2018	a	Harvested Oats for grain yield - Section 4 only	-	-

W Beans

10/10/2017	a	Ring rolled - Section 7		
10/10/2017	s	Drilled Tundra - Section 7 only	35.00	seeds/m2
08/02/2018	p	Sprayed Crawler - Section 7	3.00	kg/ha
20/04/2018	p	Sprayed San703 - Section 7	2.00	lt/ha
20/04/2018	p	Sprayed Nutriphite Peak - Section 7	1.00	lt/ha
20/04/2018	p	Sprayed Hallmark - Section 7	75.00	ml/ha
01/06/2018	p	Sprayed San 703 - Section 7	2.00	lt/ha
01/06/2018	p	Sprayed San 703 - Section 7	2.00	lt/ha
19/06/2018	p	Sprayed Nutri peak - Section 7	1.00	lt/ha
19/06/2018	p	Sprayed aphox - Section 7	280.00	gms/ha
19/06/2018	p	Sprayed octolan - Section 7	2.00	lt/ha
19/06/2018	p	Sprayed Nutri peak - Section 7	1.00	lt/ha
19/06/2018	p	Sprayed aphox - Section 7	280.00	gms/ha
19/06/2018	p	Sprayed octolan - Section 7	2.00	lt/ha
14/08/2018	a	Harvested Bean Plots for Yield	-	-

28/08/2018	a	Completed Straw Weights on sections 7	-	-

Wilderness

26/04/2018	a	Topped Broadbalk wilderness – Middle Section
15/05/2018	a	Topped Broadbalk wilderness – Middle Section

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	2/W1	3/W1	5/W2	6/W41	0/W14	1/W52	9/W60	8/W2	Mean
01(FYM)N4	6.36	8.31	7.46	4.14	-	-	-	-	6.57
21FYMN3	8.30	8.96	9.26	5.02	7.65	8.26	7.87	4.22	7.44
22FYM	6.12	7.16	5.05	5.09	5.65	6.89	6.36	4.53	5.85
03Nil	0.40	0.95	0.69	1.31	0.57	0.52	0.44	1.84	0.84
05(P)KMg	0.45	0.24	0.53	1.29	0.68	0.85	0.52	1.73	0.79
06N1(P)KMg	2.38	2.55	2.05	3.12	2.71	2.17	2.56	3.14	2.59
07N2(P)KMg	3.95	4.34	4.28	3.79	4.60	4.85	4.59	3.51	4.24
08N3(P)KMg	6.06	7.20	5.66	4.36	5.11	5.20	6.38	5.01	5.62
09N4(P)KMg	6.21	8.14	6.42	4.63	4.99	5.92	6.97	6.29	6.20
10N4	0.58	0.81	3.17	1.93	1.08	1.21	1.06	3.75	1.70
11N4PMg	5.84	5.86	6.21	3.00	4.67	5.88	5.03	4.36	5.11
12N1+3+1(P)KMg	5.95	7.66	7.17	4.68	5.89	6.82	7.21	6.66	6.51
13N4PK	6.17	7.27	6.34	4.69	5.57	6.17	7.16	5.45	6.10
14N4PK-(Mg-)	3.40	4.49	3.82	5.29	4.57	5.15	6.56	5.95	4.90
15N5(P)KMg	6.57	8.08	6.63	4.32	5.46	6.40	6.49	4.52	6.06
16N6(P)KMg	6.07	8.16	7.46	4.42	5.84	6.47	7.38	5.23	6.38
17N1+4+1PKMg	6.38	8.74	7.50	4.47	5.89	6.23	7.22	6.08	6.56
18N1+2+1PKMg	6.29	8.12	7.18	4.63	5.66	5.46	7.08	5.79	6.28
19N1+1+1KMg	4.71	6.81	5.61	3.99	5.04	3.61	6.03	4.86	5.08
20N4KMg	-	-	-	-	1.21	0.58	-	-	0.90
Mean	4.85	5.99	5.39	3.90	4.36	4.67	5.38	4.61	4.89

Grain Mean DM% 90.3

Note: Half of plot 148 was accidently sprayed with herbicide in 2018, but yields shown are from the unsprayed half.

Straw Tonnes/Hectare (85% DM)

Tables of means

Section	2/W1	3/W1	5/W2	6/W41	0/W14	1/W52	9/W60	8/W2	Mean
Plot									
01(FYM)N4	2.03	3.48	-	-	-	-	-	-	2.75
21FYMN3	4.29	5.97	-	-	-	5.46	-	5.96	5.42
22FYM	2.29	3.12	-	-	-	2.67	-	4.04	3.03
03Nil	0.08	0.16	-	-	-	0.20	-	0.17	0.16
05(P)KMg	0.16	0.19	-	-	-	0.14	-	1.26	0.43
06N1(P)KMg	0.82	0.91	-	-	-	0.87	-	1.57	1.04
07N2(P)KMg	1.22	1.32	-	-	-	1.44	-	1.91	1.47
08N3(P)KMg	1.71	2.13	-	-	-	1.82	-	3.03	2.17
09N4(P)KMg	1.71	2.78	-	-	-	2.54	-	3.09	2.53
10N4	0.53	0.59	-	-	-	0.64	-	1.43	0.80
11N4PMg	1.57	2.02	-	-	-	2.15	-	3.17	2.23
12N1+3+1(P)KMg	2.08	2.76	-	-	-	2.24	-	3.01	2.52
13N4PK	1.82	1.83	-	-	-	2.16	-	2.99	2.20
14N4PK-(Mg-)	1.27	1.14	-	-	-	1.95	-	2.46	1.70
15N5(P)KMg	2.18	2.86	-	-	-	2.41	-	4.15	2.90
16N6(P)KMg	1.99	3.41	-	-	-	2.87	-	3.77	3.01
17N1+4+1PKMg	2.35	3.75	-	-	-	2.66	-	5.06	3.46
18N1+2+1PKMg	1.93	2.63	-	-	-	1.83	-	4.16	2.64
19N1+1+1KMg	1.43	2.19	-	-	-	1.58	-	3.53	2.18
20N4KMg	-	-	-	-	-	0.22	-	-	0.22
Mean	1.66	2.28	-	-	-	1.89	-	3.04	2.20
Straw Mean DM%	82.5								

WINTER OAT

Tonnes/Hectare (85% DM)

Table of means

Plot	Treatment	Grain	Straw
14	01(FYM)[1/2N4]	3.83	1.76
214	21[FYM1/2N3]	5.87	2.02
224	22[FYM]	3.63	1.52
34	03Nil	0.89	0.24
54	05(P)KMg	1.03	0.34
64	06[1/2N1](P)KMg	1.97	0.73
74	07[1/2N2](P)KMg	2.65	0.92
84	08[1/2N3](P)KMg	3.15	1.10
94	09[1/2N4](P)KMg	3.73	1.40
104	10[1/2N4]	2.86	1.50

114	11[1/2N4]PMg	4.25	2.19
124	12[1/2N5(P)KMg	2.93	1.12
134	13[1/2N4]PK	3.01	0.88
144	14[1/2N4]PK*(Mg*)	3.97	1.06
154	15[1/2N5](P)KMg	4.51	1.18
164	16[1/2N6](P)KMg	5.27	1.83
174	17[1/2N6]PKMg	4.73	1.76
184	18[1/2N4]PKMg	3.18	1.33
194	19[1/2N3]KMg	2.56	0.85
	Mean	3.37	1.25
Plot Area Harvested	0.00463		

Note: N was applied late to Winter Oats and meant that it was not fully mature at harvest.

WINTER BEANS

TONNES/HECTARE (85% DM)

Tables of means

Plot	Treatment	Grain	Straw
17	01(FYM)[1/2N4]	4.84	3.28
217	21[FYM1/2N3]	4.14	2.80
227	22[FYM]	4.18	4.31
37	03Nil	0.73	0.05
57	05(P)KMg	4.55	2.33
67	06[1/2N1](P)KMg	4.42	2.13
77	07[1/2N2](P)KMg	4.20	2.37
87	08[1/2N3](P)KMg	4.13	1.96
97	09[1/2N4](P)KMg	4.14	2.15
107	10[1/2N4]	0.94	0.35
117	11[/2N4]PMg	0.12	1.24
127	12[1/2N5](P)KMg	3.90	1.62
137	13[1/2N4]PK	4.26	1.73
147	14[1/2N4]PK*(Mg*)	4.79	1.93
157	15[N5](P)KMg	3.98	1.43
167	16[N6](P)KMg	4.36	2.10
177	17[N6]PKMg	4.45	2.46
187	18[N4]PKMg	4.76	2.73
197	19[N3]KMg	3.40	1.83
	MEAN	3.70	2.04
	Mean DM%	87.2	84.5
PLOT AREA HARVESTED		0.00453	

Note: 1.0 m^2 of bean crop was removed by hand before harvesting the yield strips on section 7. The combine yields were adjusted to account for the crop removal. The hand harvested material was threshed separately to obtain accurate straw weights.

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

YEAR	**2018**
SECTION	**8/W2**
PLOT	
01(FYM)N4	-
21FYMN3	3.73
22FYM	4.19
03Nil	1.77
05(P)KMg	1.43
06N1(P)KMg	2.90
07N2(P)KMg	3.22
08N3(P)KMg	4.55
09N4(P)KMg	5.48
10N4	3.55
11N4PMg	3.67
12N1+3+1(P)KMg	6.09
13N4PK	4.93
14N4PK*(Mg*)	5.47
15N5(P)KMg	3.96
16N6(P)KMg	4.60
17N1+4+1PKMg	5.25
18N1+2+1PKMg	5.19
19N1+1+1KMg	4.35
20N4KMg	-
Mean	4.13

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.

18/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 167th year, spring barley.

For previous years see 'Details' 1967 and 1973, Station Report for 1966 and Yield Books for 74-17/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 2018.

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
21/09/2017	f	Applied SOP - Plots 141 - 144, 241 - 244, 311 - 344, 411 - 444, 551 - 582, 631 - 634	217	kg/ha
21/09/2017	a	Ring Rolled all Field	-	-
22/09/2017	p	Sprayed Buffalo Elite	1	lt/ha
22/09/2017	p	Sprayed Buffalo Samurai	5	lt/ha
07/11/2017	f	Applied TSP - plots 634-631	215	kg/ha
08/11/2017	f	Applied Kiserite - plots 634-631	233	kg/ha
04/12/2017	f	Applied FYM plots 721-734	35	t/ha
04/12/2017	f	Applied silicote of soda - plots 432-132 + 433-133	450	kg/ha
05/12/2017	a	Ploughed - thrown South	-	-
23/03/2018	a	Cousins Combi Harrowed	-	-
26/03/2018	s	Drilled KWS Irina - Trt Raxial Star	350	seed/m^2
26/03/2018	a	Ring Rolled	-	-
15/05/2018	a	rotavated paths	-	-
15/05/2018	f	Applied Nitrochalk (27% N) to Plots 112, 123, 212, 223, 314, 324, 414, 422, 613, 624, 634, 711, 722, 731	48	kg/ha
15/05/2018	f	Applied Nitrochalk (27% N) to Plots 114, 122, 213, 224, 312, 323, 411, 424, 612, 622, 632, 714, 723, 733	96	kg/ha
15/05/2018	f	Applied Nitrochalk (27% N) to Plots 111, 121, 214, 221, 311, 322, 413, 423, 614, 623, 634, 713, 724, 734	144	kg/ha
21/05/2018	f	Applied Nitram (34.5%) - applied to strip 5, series C and series AA	417	kg/ha
04/06/2018	p	Sprayed PresiteSX	60	gms/ha
04/06/2018	p	Sprayed Axial	300	ml/ha
04/06/2018	p	Sprayed Vortex	1	lt/ha
04/06/2018	p	Sprayed Hurler	700	ml/ha
04/06/2018	p	Sprayed Adigor	1	lt/ha
13/07/2018	a	cut paths	-	-
20/08/2018	a	harvested all plots for yield	-	-
22/08/2018	a	Baled and removed surrounds	-	-
22/08/2018	a	Harvested Plots Sides to open up for baling	-	-
30/08/2018	a	Completed Straw Weights	-	-

Yields

Main Plots

Grain Yield, tonnes/hectare
Table of means

N	0	48	96	144	Mean
MANURE					
---	1.00	0.95	1.03	0.86	0.96
-P-	1.72	2.77	3.08	2.66	2.56
--K	0.49	0.56	0.74	0.91	0.67
-PK	0.96	1.97	2.56	2.83	2.08
A--	1.27	1.29	1.07	0.90	1.13
AP-	2.22	3.10	3.61	3.02	2.99
A-K	0.35	0.91	0.82	0.71	0.70
APK	0.55	1.48	2.49	2.54	1.77
FYM1852onwards	4.69	5.53	5.40	5.07	5.17
FYM1852-1871	0.93	0.89	3.42	1.96	1.80
(A)	1.39	2.42	2.19	1.88	1.97
-	0.44	1.25	1.32	1.55	1.14
FYM2001onwards	4.12	4.84	4.73	4.46	4.54
P2K	1.61	2.03	3.64	3.37	2.66
Mean	1.55	2.14	2.58	2.34	2.15

Grain mean DM%	85.2

Straw Yield, tonnes/hectare
Table of means

N	0	48	96	144	Mean
MANURE					
---	0.34	0.37	0.24	0.30	0.31
-P-	0.49	0.76	1.02	0.79	0.76
--K	0.15	0.13	0.21	0.29	0.20
-PK	0.22	0.62	0.87	1.29	0.75
A--	0.28	0.39	0.22	0.28	0.29
AP-	0.56	1.03	1.20	0.73	0.88
A-K	0.12	0.24	0.31	0.13	0.20
APK	0.17	0.46	1.12	1.39	0.78
FYM1852onwards	1.88	2.91	3.08	3.27	2.78
FYM1852-1871	0.25	0.13	1.24	0.78	0.60
(A)	0.35	0.81	0.68	0.45	0.57
-	0.10	0.30	0.39	0.42	0.30
FYM2001onwards	1.84	1.84	2.33	2.76	2.19
P2K	0.40	0.95	1.67	1.61	1.16
Mean	0.51	0.78	1.04	1.04	0.84

Grain mean DM%	86.9

Note: Grain yields were relatively low due to dry summer conditions in 2018.

PHOSPHATE PLOTS

Grain Yield, tonnes/hectare

Tables of means

PLOTS	
142	2.19
143	1.81
144	1.76
242	3.51
243	3.27
244	3.06
341	2.00
342	2.42
343	1.55
344	1.73
441	3.00
442	3.29
443	2.80
444	2.20
551	1.20
552	1.03
561	1.78
562	1.06
571	1.46
572	1.47
581	0.72
582	0.78
Mean	2.01
Grain Mean DM%	86.4
Plot area Harvested	0.00244

SILICATE PLOTS

Grain Yield, tonnes/hectare

Tables of means

PK	N3--	N3P-	N3-K	N3PK	Mean
Silicate					
(-)-	1.59	3.19	1.10	3.15	2.26
(Si)-	1.44	2.57	1.49	3.42	2.23
(-)Si	2.34	3.13	1.36	3.01	2.46
(Si)Si	2.34	2.70	1.75	2.44	2.31
Mean	1.93	2.90	1.42	3.00	2.31
Grain Mean DM%	86.8				
Plot area harvested	0.00244				

18/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 74-17/R/WF/3.

Experimental Diary

Date		Application	Rate	Units
26/09/2017	p	Sprayed Buffalo Elite - sprayed of stubbles	1.00	lt/ha
26/09/2017	p	Sprayed Samurai - sprayed of stubbles	3.00	lt/ha
09/10/2017	a	Ploughed - Thrown South	-	-
17/10/2017	p	Sprayed Pontos	1.00	lt/ha
17/10/2017	p	Sprayed Jade	3.00	lt/ha
17/10/2017	p	Sprayed Velomax	400.00	ml/ha
17/10/2017	a	Ring Rolled	-	-
17/10/2017	p	Sprayed Pontos	1.00	lt/ha
17/10/2017	p	Sprayed Jade	3.00	lt/ha
17/10/2017	p	Sprayed Velomax	400.00	ml/ha
15/11/2017	p	Sprayed Hallmark	50.00	ml/ha
17/11/2017	s	Drilled Crusoe, trt Beret Gold	350.00	seed/m2
03/05/2018	f	Applied Nitram	145.00	kg/ha
03/05/2018	p	Sprayed Keystone	800.00	ml/ha
03/05/2018	p	Sprayed Balear 720 SC	700.00	ml/ha
03/05/2018	p	Sprayed Stefes CCC720	2.00	lt/ha
24/05/2018	p	Sprayed Vortex - sprayed WW	1.50	lt/ha
24/05/2018	p	Sprayed Bassoon EC - sprayed WW	500.00	ml/ha
06/06/2018	p	Sprayed Cello	630.00	ml/ha
04/08/2018	a	Harvested Wheat	-	-

18/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 163rd year, winter wheat.

For previous years see 'Details' 1977, 1973 and Yield Books for 74-17/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
20/09/2017	f	Applied MOP - plots 023, 043, 063, 083, 103	125.0	kg/ha
20/09/2017	f	Applied MOP - plots 024, 044, 064, 084, 104 and plots 011 to 094	250.0	kg/ha
20/09/2017	f	Applied TSP - plots 011-012, 021-024, 031-032, 041-044, 051- 052, 061-064, 071-072, 081-084, 091-092 and plots 101 to 104	75.0	kg/ha
26/09/2017	p	Sprayed Buffalo Elite - sprayed off stubbles	1.0	lt/ha
26/09/2017	p	Sprayed Samurai - sprayed off stubbles	3.0	lt/ha
09/10/2017	a	Ploughed - thrown South	-	-
10/10/2017	a	Ploughed - thrown South	-	-
13/10/2017	s	Drilled Crusoe, Beret Gold & Deter	350.0	seeds/m2
17/10/2017	p	Sprayed Pontos	1.0	lt/ha
17/10/2017	p	Sprayed Jade	3.0	lt/ha
17/10/2017	p	Sprayed Velomax	400.0	ml/ha
17/10/2017	a	Ring Rolled	-	-
17/10/2017	p	Sprayed Pontos	1.0	lt/ha
17/10/2017	p	Sprayed Velomax	400.0	ml/ha

17/10/2017	p	Sprayed Jade	3.0	lt/ha
15/11/2017	p	Sprayed Hallmark	50.0	ml/ha
24/04/2018	f	Applied Sulphate of Ammonia	238.0	kg/ha
24/04/2018	f	Applied Kiserite	80.0	kg/ha
03/05/2018	f	Applied Nitram	580.0	kg/ha
03/05/2018	p	Sprayed Keystone	800.0	ml/ha
03/05/2018	p	Sprayed Balear 720 SC	700.0	ml/ha
03/05/2018	p	Sprayed Stefes CCC720	2.0	lt/ha
17/05/2018	f	Applied Nitram	145.0	kg/ha
24/05/2018	p	Sprayed Vortex - Winter Wheat Only	1.5	lt/ha
24/05/2018	p	Sprayed Bassoon EC - Winter Wheat Only	500.0	ml/ha
06/06/2018	p	Sprayed Cello	630.0	ml/ha
04/07/2018	a	cut paths	-	-
04/08/2018	a	Harvested Wheat	-	-
08/08/2018	a	Harvested All Wheat Plots for Yield	-	-

Yields

P TEST

Grain Yield, tonnes/hectare

Tables of means

P_RES OLD_RES	O	(P1)	(P2)	(P3)	Mean
O	1.61	3.56	5.03	5.42	3.90
D	2.41	5.49	7.52	7.34	5.69
N	1.41	4.20	5.65	6.14	4.35
P	2.46	5.31	6.09	6.76	5.15
NPKNAMG	1.98	5.55	6.64	6.71	5.22
Mean	1.97	4.82	6.19	6.47	4.86

Grain mean DM% 90.6

Straw Yield, tonnes/hectare

Tables of means

P_RES	O	(P1)	(P2)	(P3)	Mean
OLD_RES					
O	0.82	2.06	3.76	3.17	2.45
D	1.85	3.35	4.77	3.48	3.36
N	0.94	2.31	3.94	2.90	2.52
P	1.94	2.78	2.97	2.89	2.64
NPKNAMG	1.50	2.84	2.80	2.78	2.48
Mean	1.41	2.67	3.65	3.04	2.69

Straw mean DM% 94.3

Plot area harvested 0.00512.

K TEST

Grain Yield, tonnes/hectare

Tables of means

K_Test	K0	K1	K2	Mean
OLD_RES				
O	5.86	6.43	6.50	6.16
D	6.71	7.07	7.08	6.89
N*	6.15	6.46	6.85	6.40
PK	6.81	6.19	6.50	6.58
N*PK	6.79	6.09	7.32	6.75
Mean	6.47	6.45	6.85	6.56

Grain mean DM% 90.7

Straw Yield, tonnes/hectare

Tables of means

K_Test	K0	K1	K2	Mean
OLD_RES				
O	3.06	2.96	3.41	3.12
D	3.15	3.28	3.39	3.24
N*	2.96	2.81	3.38	3.03
PK	3.27	2.59	3.18	3.07
N*PK	3.16	2.99	2.72	3.01
Mean	3.12	2.93	3.22	3.10

Straw mean DM% 94.6

Plot area harvested 0.00512

18/R/PG/5 PARK GRASS

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

The 163rd year, hay.
For previous years see 'Details' 1977 and 1973 and Yield Books for 74-17/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 2017-2018; the nineth application in a triennial scheme of soil pH analysis and remedial chalk applications.

[This note was incorrect in earlier (97-01/R/PG/5) 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 (97-01/R/PG/5) Yield book entries. See further details on the e-RA website at http://www.era.rothamsted.ac.uk]

Experimental Diary

Date		Application	Rate	Units
30/10/2017	a	Mown all field	-	-
31/10/2017	a	Continued Mowing Field and Rowed up cut grass	-	-
30/01/2018	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	83.00	kg/ha
30/01/2018	f	Applied TSP - plot 20	73.00	kg/ha
06/02/2018	f	Applied Sulphate of Potash - plot 20	542.00	kg/ha
06/02/2018	f	Applied Sulphate of Soda - plots 8, 10, 11/2, 18	43.00	kg/ha
06/02/2018	f	Applied Sulphate of Magnesia - plots 8, 10, 11/2, 18	111.00	kg/ha
06/02/2018	f	Applied Silicate of Soda - plot 11/2	450.00	kg/ha
07/02/2018	f	Applied Sulphate of Potash - plots 2-1, 6, 7/1, 7/2, 9-1, 9-2, 11-1, 14-1, 14-2, 15, 16	542.00	kg/ha
07/02/2018	f	Applied Sulphate of Soda - plots 6, 7/1, 7/2, 9-1, 9-2, 11-1, 14-1, 14-2, 15, 16	43.00	kg/ha
07/02/2018	f	Applied Sulphate of Magnesia - plots 6, 7/1, 7/2, 9-1, 9-2, 11-1, 14-1, 14-2, 15, 16	111.00	kg/ha
21/02/2018	f	Applied Chalk - Plots 2/2c, 3c	0.15	t/ha
21/02/2018	f	Applied Chalk - Plots 15b, 16b, 2/1c, 4/1c, 7/1c, 7/2c, 12/c, 13/1c	0.30	t/ha
21/02/2018	f	Applied Chalk - Plots 2/2a, 2/2b, 3b, 4/1b, 8b, 13/2b, 9/1c	0.50	t/ha
21/02/2018	f	Applied Chalk - Plots 3a, 2/1b, 7/1b, 7/2b, 9/1b, 12/b, 14/1b, 4/2c	0.75	t/ha
21/02/2018	f	Applied Chalk - Plots 1b, 13/1b, 1c, 10c, 18/c	1.00	t/ha
21/02/2018	f	Applied Chalk - Plots 2/1a, 9/1a, 4/2b, 9/2b, 10b, 18/b	1.50	t/ha
21/02/2018	f	Applied Chalk - Plots 12/a, 11/1c, 11/2c	1.75	t/ha
21/02/2018	f	Applied Chalk - Plots 4/1a, 13/1a, 13/2a, 14/1a, 14/2a, 17a, 9/2c	2.00	t/ha

21/02/2018	f	Applied Chalk - Plots 1a, 7/1a, 7/2a, 8a, 9/2a, 10a, 15a, 16a, 6b, 11/1b, 11/2b	2.50	t/ha
21/02/2018	f	Applied Chalk - Plot 11/2a	3.00	t/ha
21/02/2018	f	Applied Chalk - Plot 11/1a	3.50	t/ha
21/02/2018	f	Applied Chalk - Plots 4/2a, 6a, 18/a	4.00	t/ha
01/05/2018	f	Applied Sulphate of Ammonia - plots 1, 6a, 6b	229.00	kg/ha
01/05/2018	f	Applied Sulphate of Ammonia - plots 4/2, 9/2, 10, 18	457.00	kg/ha
01/05/2018	f	Applied Sulphate of Ammonia - plots 11/1, 11/2	686.00	kg/ha
01/05/2018	f	Applied Sodium Nitrate - plots 16, 17	300.00	kg/ha
01/05/2018	f	Applied Sodium Nitrate - plot 14/2	600.00	kg/ha
01/05/2018	f	Applied Sodium Nitrate - plot 15	900.00	kg/ha
01/05/2018	f	Applied Sodium Nitrate - plot 20	188.00	kg/ha
21/05/2018	a	Cut Paths	-	-
04/06/2018	a	cut paths	-	-
19/06/2018	a	cut paths	-	-
27/06/2018	a	started cutting plots for yield	-	-
28/06/2018	a	completed grass yields	-	-
28/06/2018	a	mowed all field	-	-
28/06/2018	a	turned all field	-	-
30/06/2018	a	turned all field	-	-
12/10/2018	a	Cut Paths	-	-
18/10/2018	a	Started harvest for grass yield	-	-
19/10/2018	a	Completed Grass Yields	-	-
23/10/2018	a	Cut All Grass on field	-	-
23/10/2018	a	Rowed up all grass	-	-
24/10/2018	a	Baled and Removed Grass	-	-

NOTE: Samples of herbage (1st and 2nd Cut) were taken for chemical analysis. Unground herbage samples from all plots were archived. N Application was a little later than usual; early May instead of mid-April.

Yields

1ST CUT (27-28 JUN 2018) DRY MATTER, TONNES/HECTARE

Tables of means

Grand mean 3.77

Manure		Lime	a	b	c	d	Mean
N1	1		2.70	2.04	1.36	1.30	1.85
K	2/1		2.93	3.06	1.72	1.41	2.28
None(FYM)	2/2		2.96	2.85	2.41	2.01	2.56
None	3		2.40	2.81	1.92	1.53	2.17
P	4/1		3.05	3.47	2.73	1.98	2.81
N2P	4/2		2.04	2.24	2.19	1.15	1.91
N1PKNaMg	6		5.34	4.53	-	-	4.93
(P)KNaMg	7/1		5.83	6.25	4.72	2.84	4.91
PKNaMg	7/2		5.47	5.62	5.41	3.52	5.00
PNaMg	8		2.71	3.46	2.66	2.61	2.86
PKNaMg(N2)	9/1		5.00	5.34	4.24	1.36	3.99
N2PKNaMg	9/2		5.62	5.81	4.30	3.44	4.79
N2PNaMg	10		3.41	3.74	3.26	2.31	3.18
N3PKNaMg	11/1		5.91	5.75	5.13	3.94	5.18
N3PKNaMgSi	11/2		7.20	4.92	4.53	5.16	5.45
None	12		2.29	1.93	1.84	1.88	1.99
(FYM/F)	13/1		3.09	3.84	2.64	2.67	3.06
FYM/PM	13/2		3.76	4.19	4.72	4.13	4.20
PKNaMg(N2*)	14/1		5.21	5.25	4.85	4.79	5.03
N2*PKNaMg	14/2		6.08	6.40	4.96	5.28	5.68
N3*PKNaMg(N2*)	15		5.53	5.53	4.50	5.01	5.14
N1*PKNaMg	16		4.92	5.68	4.48	3.94	4.76
N1*	17		2.31	2.67	2.14	2.57	2.42
N2KNaMg	18		3.44	3.90	3.25	2.87	3.37
N2KNaMg	18/2		-	-	-	-	4.60
FYM	19/1		-	-	-	-	4.47
FYM	19/2		-	-	-	-	5.20
FYM	19/3		-	-	-	-	4.30
FYM/N*PK	20/1		-	-	-	-	5.25
FYM/N*PK	20/2		-	-	-	-	4.97
FYM/N*PK	20/3		-	-	-	-	4.60

1st cut mean DM% 37.0

2ND CUT (18 OCT 2018) DRY MATTER, TONNES/HECTARE

Tables of means

Grand mean **1.10**

Manure	Lime	a	b	c	d	Mean
N1 1		0.91	0.89	0.64	0.23	0.67
K 2/1		0.66	0.58	0.32	0.49	0.51
None(FYM) 2/2		0.79	0.75	0.84	0.83	0.8
None 3		0.71	0.72	0.66	0.59	0.67
P 4/1		0.74	0.86	1.05	0.90	0.89
N2P 4/2		0.69	0.88	0.71	0.60	0.72
N1PKNaMg 6		1.19	1.12			1.16
(P)KNaMg 7/1		1.49	1.42	1.03	0.89	1.21
PKNaMg 7/2		1.44	1.46	1.27	0.93	1.27
PNaMg 8		0.92	0.91	0.91	1.19	0.99
PKNaMg(N2) 9/1		1.31	1.19	0.71	0.30	0.88
N2PKNaMg 9/2		1.40	1.39	0.54	0.59	0.98
N2PNaMg 10		0.87	0.97	0.82	0.74	0.85
N3PKNaMg 11/1		1.97	1.54	1.12	0.59	1.31
N3PKNaMgSi 11/2		2.50	2.15	1.36	0.78	1.7
None 12		1.03	0.89	0.99	0.75	0.92
(FYM/F) 13/1		1.59	1.39	0.96	0.62	1.14
FYM/PM 13/2		1.51	1.83	1.78	1.42	1.64
PKNaMg(N2*) 14/1		1.41	1.31	1.15	1.27	1.28
N2*PKNaMg 14/2		1.81	2.21	2.20	2.19	2.1
N3*PKNaMg(N2*) 15		1.92	2.00	1.23	1.04	1.55
N1*PKNaMg 16		1.45	1.71	0.98	0.85	1.25
N1* 17		0.82	0.99	0.88	0.99	0.92
N2KNaMg 18		0.77	0.65	0.46	0.13	0.5
N2KNaMg 18/2						0.71
FYM 19/1						1.04
FYM 19/2						1.78
FYM 19/3						1.52
FYM/N*PK 20/1						1.74
FYM/N*PK 20/2						1.87
FYM/N*PK 20/3						1.35

2nd cut mean DM% 18.00

TOTAL OF 2 CUTS DRY MATTER, TONNES/HECTARE

Tables of means

Grand mean 4.87

Manure		Lime	a	b	c	d	Mean
N1	1		3.60	2.93	2.00	1.53	2.52
K	2/1		3.59	3.64	2.04	1.90	2.79
None(FYM)	2/2		3.75	3.61	3.25	2.84	3.36
None	3		3.11	3.53	2.58	2.12	2.84
P	4/1		3.79	4.32	3.77	2.88	3.69
N2P	4/2		2.73	3.13	2.89	1.75	2.62
N1PKNaMg	6		6.52	5.65			6.09
(P)KNaMg	7/1		7.32	7.67	5.76	3.73	6.12
PKNaMg	7/2		6.91	7.07	6.67	4.44	6.28
PNaMg	8		3.63	4.38	3.57	3.81	3.84
PKNaMg(N2)	9/1		6.31	6.53	4.95	1.66	4.86
N2PKNaMg	9/2		7.02	7.19	4.84	4.03	5.77
N2PNaMg	10		4.28	4.70	4.08	3.05	4.03
N3PKNaMg	11/1		7.88	7.29	6.25	4.53	6.49
N3PKNaMgSi	11/2		9.70	7.07	5.89	5.93	7.15
None	12		3.33	2.82	2.84	2.63	2.90
(FYM/F)	13/1		4.69	5.23	3.61	3.29	4.20
FYM/PM	13/2		5.28	6.02	6.50	5.55	5.84
PKNaMg(N2*)	14/1		6.62	6.56	6.01	6.06	6.31
N2*PKNaMg	14/2		7.89	8.61	7.17	7.47	7.79
N3*PKNaMg(N2*)	15		7.45	7.53	5.73	6.05	6.69
N1*PKNaMg	16		6.37	7.40	5.46	4.80	6.01
N1*	17		3.13	3.66	3.02	3.56	3.34
N2KNaMg	18		4.21	4.55	3.71	3.01	3.87
N2KNaMg	18/2						5.30
FYM	19/1						5.51
FYM	19/2						6.98
FYM	19/3						5.82
FYM/N*PK	20/1						6.99
FYM/N*PK	20/2						6.84
FYM/N*PK	20/3						5.95

TOTAL OF 2 CUTS
Mean DM% 27.46

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

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

The 165th year, red clover.

For previous years see `Details' 1967 and 1973, and Yield books for 74-17/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
10/11/2017	f	Applied Epsom Salts	50	kg/ha
10/11/2017	f	Applied TSP	75	kg/ha
10/11/2017	f	Applied Potassium Sulphate	150	kg/ha
10/11/2017	f	Applied Chalk.	1.25	t/ha
17/04/2018	a	Hand weeded	-	-
04/06/2018	a	First Cut	-	-
19/07/2017	a	Second Cut	-	-
09/10/2018	a	Third Cut	-	-

Yields

Dry Matter, Tonnes/Hectare

			FUNG_RES		
Cut	Date	Grand Mean	NONE	BENOMYL	Mean DM%
1st	04 JUN 2018	2.54	2.36	2.72	19.70
2nd	19 JUL 2018	1.38	1.36	1.39	39.90
3rd	09 OCT 2018	0.20	0.23	0.18	26.90
Total of 3 cuts		4.12	3.95	4.29	28.80

18/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 74-17/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. The new rotations were fully in phase by 2016.

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

Whole plots:

1. **ROTATION** Rotations before wheat:
   LLN 8

   LN 3

   LLC 8

   LC 3

   LLC/LC3

   LLN/LN3

   LLN/AO

   LLC/ABe

   AM/AO

ABe

1/ 2 plots:

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 2018 (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

LLN/LN3

LLN/AO

LLC/ABe

AM/AO

ABe

1/ 2 plots:

2. **NSPLIT (FYM res)** Farmyard manure residues, last applied 1960s:
N split to rye (no FYM)

N single to rye (FYM)

1/8 plots:

3. **N** Nitrogen fertilizer in spring 2018 (kg N) as 34.5% (mid-April):
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	150	170
AO/O	100	240
LLn/AO	200	100
LLn/ABe	150	150

None to other plots.

Experimental Diary

Date		Application	Rate	Units
ALL				
20/10/2017	f	Applied chalk to all plots on Block 5	5	t/ha
21/10/2017	a	Plough Started - Thrown East	-	-
23/10/2017	a	Power harrowed	-	-
29/10/2017	a	Topped	-	-
30/10/2017	a	Plough Finished	-	-
17/11/2017	f	Applied TSP (46% P_2O_5) – Arable plots	127	kg/ha
17/11/2017	a	Completed Grass Yields	-	-
20/04/2018	p	Sprayed Chex	250	ml/ha
20/04/2018	p	Sprayed CINTAC	500	g/ha
20/04/2018	p	Sprayed Hiatus	75	g/ha
20/04/2018	p	Sprayed Cogent	1	lt/ha
20/04/2018	a	Springtyned - Grass plots	-	-
20/04/2018	a	Rolled plots - Grass	-	-

01/05/2018	f	Applied SOP (50% K_2O, 45% SO_3) - Arable plots	150	kg/ha
04/05/2018	p	Sprayed Sprinter	2	lt/ha
04/05/2018	p	Sprayed Keystone	800	ml/ha
04/05/2018	p	Sprayed Balear720sc	700	ml/ha
04/05/2018	p	Sprayed Stabilan 750	2	lt/ha
05/06/2018	a	Topping - Surrounds or trials and Paths	-	-
13/06/2018	p	Spraying Sprinter	2	lt/ha
13/06/2018	p	Spraying Cello	630	ml/ha
20/06/2018	a	Topping - Grass areas and Paths	-	-

Grass ley and clover/grass leys (first year leys)

15/11/2017	f	Applied TSP (46% P_2O_5) - 1st Ley; Plots 33, 34, 37, 38, 41 to 44	213	kg/ha
17/11/2017	f	Applied SOP (50% K_2O, 45% SO_3) - 1st Ley; Plots 33, 34, 37, 38, 41 to 44	140	kg/ha
17/11/2017	f	Applied Nitram (34.5% N) - 1st ley; Plots 33, 34, 41, 42	72	kg/ha
17/11/2017	f	Applied Nitram (34.5% N) - 1st ley; Plots 37, 38, 43, 44	145	kg/ha
01/05/2018	f	Applied Nitram (34.5% N) - Grass only; Plots 37, 38, 43, 48	217	kg/ha
01/05/2018	f	Applied MOP (60% K_2O) - Grass leys; Plots 33, 34, 37, 38, 41 to 44	167	kg/ha

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

15/11/2017	f	Applied TSP (46% P_2O_5) - 2nd-3rd Leys; Plots Plots 3, 4, 7, 8, 11 to 14, 23 to 26, 29 to 32	213	kg/ha
17/11/2017	f	Applied SOP (50% K_2O, 45% SO_3) - 2nd-3rd leys; Plots Plots 3, 4, 7, 8, 11 to 14, 23 to 26, 29 to 32	140	kg/ha
01/05/2018	f	Applied Nitram (34.5% N) - Grass only; Plots 11 to 14, 25, 26, 31, 32	217	kg/ha

01/05/2018	f	Applied MOP (60% K2O) - Grass leys; Plots 3, 4, 7, 8, 11 to 14, 23 to 26, 29 to 32	167	kg/ha

W Beans / SP Beans

05/12/2017	s	Drilled Winter Beans cv. Tundra	30	seeds/m2
23/04/2018	a	springtyned - Beans only	-	-
25/04/2018	s	Drilled Spring Beans cv. Fuego (Winter Beans Failed)	40	seeds/m2

W Wheat

15/11/2017	f	Applied MOP (60% K_2O) as corrective K - Plots 52, 64	100	kg/ha
15/11/2017	f	Applied MOP (60% K_2O) as corrective K - Plots 49, 50, 53	150	kg/ha
15/11/2017	f	Applied MOP (60% K_2O) as corrective K - Plots 54	170	kg/ha
15/11/2017	f	Applied MOP (60% K_2O) as corrective K - Plots 51	200	kg/ha
15/11/2017	f	Applied MOP (60% K_2O) as corrective K - Plots 63	240	kg/ha
05/12/2017	s	Drilled Winter Wheat cv. Crusoe	350	seeds/m2
25/04/2018	f	Applied Nitrochalk (27% N) - Wheat	148	kg/ha
01/05/2018	f	Applied Nitrochalk (27% N) - Wheat; Plots 491, 501, 511, 521, 531, 542, 553, 562, 574, 583, 592, 602, 612, 623, 633, 642	148	kg/ha
01/05/2018	f	Applied Nitrochalk (27% N) - Wheat; Plots 493, 502, 514, 522, 533, 544, 551, 561, 573, 582, 594, 604, 613, 621, 631, 644	444	kg/ha
01/05/2018	f	Applied Nitrochalk (27% N) - Wheat; Plots 492, 503, 512, 524, 534, 543, 554, 563, 572, 584, 593, 603, 614, 624, 634, 641	741	kg/ha
03/06/2018	p	Sprayed Hurler - Wheat	500	ml/ha
03/06/2018	p	Sprayed Sprinter - Wheat	2	lt/ha
03/06/2018	p	Sprayed BassonEC - Wheat	1.5	lt/ha
03/06/2018	p	Sprayed Vivid - Wheat	500	ml/ha

W Rye

20/11/2017	f	Chalk; Block 5 - plots 65 to 80	5	t/ha
05/12/2017	s	Drilled Winter Rye cv. Mephisto	400	seeds/m2
20/04/2018	p	Sprayed Chex - Rye	250	ml/ha
20/04/2018	p	Sprayed Atlantis - Rye	400	ml/ha
20/04/2018	p	Sprayed Hiatus - Rye	50	g/ha
20/04/2018	p	Sprayed Cogent - Rye	1	lt/ha
26/04/2018	f	Applied Nitrochalk (27% N) - Rye; Plots 651, 662, 674, 684, 693, 701, 714, 722, 733, 743, 754, 761, 774, 781, 793, 804	185	kg/ha
26/04/2018	f	Applied Nitrochalk (27% N) - Rye; Plots 654, 661, 671, 683, 691, 703, 712, 723, 734, 741, 752, 764, 773, 784, 794, 801	370	kg/ha
26/04/2018	f	Applied Nitrochalk (27% N) - Rye; Plots 652, 664, 673, 681, 694, 704, 711, 724, 731, 742, 753, 762, 772, 783, 792, 802	556	kg/ha
01/05/2018	f	Applied Nitram (34.5% N) - Rye; Plots 35, 36, 39, 40, 45 to 48	290	kg/ha
09/05/2018	p	Sprayed Sprinter - Rye	2	lt/ha
09/05/2018	p	Sprayed Keystone - Rye	500	ml/ha
09/05/2018	p	Sprayed Folicur - Rye	800	ml/ha
09/05/2018	p	Sprayed Moddus - Rye	100	ml/ha
09/05/2018	p	Sprayed Stefes CCC720 - Rye	2	lt/ha

W Oats

05/12/2017	s	Drilled Winter Oats cv. Miscani	350	seeds/m2
01/05/2018	f	Applied Nitram (34.5% N) - Oats; Plots 1, 2, 15, 16, 19, 20, 27, 28	290	kg/ha
03/06/2018	p	Sprayed Sprinter - Oats	2	lt/ha
03/06/2018	p	Sprayed PresiteSX - Oats	60	g/ha
03/06/2018	p	Sprayed Vortex - Oats	1	lt/ha

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

Yields

LEYS

1ST CUT (10 JUL 2018) DRY MATTER TONNES/HECTARE

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

FYM_RES

LEY	NONE	FYM	MEAN
LC1	1.00	1.18	1.09
LC2	3.11	3.86	3.48
LC3	3.38	3.66	3.52
LN1	1.93	3.36	2.64
LN2	5.10	4.76	4.93
LN3	3.81	4.21	4.01
(LLC/LC)LC1	2.08	2.30	2.19
(LLC/LC)LC2	3.44	2.25	2.84
(LLC/LC)LC3	4.08	3.57	3.83
(LLN/LN)LN1	1.66	1.67	1.66
(LLN/LN)LN2	4.29	5.12	4.70
(LLN/LN)LN3	4.90	4.56	4.73
MEAN	3.23	3.37	3.30

1ST CUT MEAN DM% 49.70

2ND CUT (16 OCT 2018) DRY MATTER TONNES/HECTARE

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

FYM_RES

LEY	NONE	FYM	MEAN
LC1	0.09	0.06	0.07
LC2	0.45	0.53	0.49
LC3	0.60	0.45	0.52
LN1	0.30	0.39	0.35
LN2	1.69	1.00	1.35
LN3	0.75	0.74	0.74
(LLC/LC)LC1	0.19	0.15	0.17
(LLC/LC)LC2	1.33	0.90	1.11
(LLC/LC)LC3	0.29	0.68	0.48
(LLN/LN)LN1	0.40	0.63	0.51
(LLN/LN)LN2	2.51	1.61	2.06
(LLN/LN)LN3	0.98	0.86	0.92

MEAN	0.80	0.67	0.73

2ND CUT MEAN DM% 19.90

Total of 2 CUTS DRY MATTER TONNES/HECTARE

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

FYM_RES LEY	NONE	FYM	MEAN
LC1	1.09	1.24	1.16
LC2	3.56	4.39	3.97
LC3	3.97	4.11	4.04
LN1	2.23	3.75	2.99
LN2	6.79	5.75	6.27
LN3	4.56	4.94	4.75
(LLC/LC)LC1	2.27	2.46	2.36
(LLC/LC)LC2	4.77	3.14	3.96
(LLC/LC)LC3	4.37	4.25	4.31
(LLN/LN)LN1	2.05	2.29	2.17
(LLN/LN)LN2	6.80	6.73	6.77
(LLN/LN)LN3	5.88	5.42	5.65
MEAN	4.03	4.04	4.03

2ND CUT MEAN DM% 34.80

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 – Winter beans failed in 2018 after late sowing and damage by crows and deer. Re-sown spring beans also failed. No yields were recorded.

RYE (EXTRA)

GRAIN (85% DRY MATTER) TONNES/HECTARE
***** Tables of means *****

FYMRES ROTATION	NONE	FYM	Mean
(ABe)R	5.30	6.39	5.85
(AO)R	4.97	6.14	5.55
(LLn/AO)R	5.73	6.66	6.20
(LLc/ABe)R	7.16	5.94	6.55
Mean	5.79	6.28	6.04
Grain mean DM%	87.7		
Plot area harvested	0.00393		

WINTER WHEAT

Grain tonnes/hectare

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

FYMRES	none	FYM	Mean
ROTATION			
(AO)W	1.97	3.23	2.60
(ABe)W	3.18	3.7	3.44
(LLn/AO)W	3.95	1.99	2.97
(LLc/ABe)W	4.81	3.60	4.21
(LN)W	3.72	3.53	3.63
(LLN/Ln)W	2.28	2.80	2.54
(LC)W	3.1	4.94	4.02
(LLc/Lc)W	3.64	2.83	3.23
Mean	3.33	3.33	3.33

N	0	80	160	240	Mean
ROTATION					
(AO)W	1.45	3.23	2.81	2.91	2.6
(ABe)W	1.73	4.62	4.46	2.94	3.44
(LLn/AO)W	2.3	3.81	2.82	2.96	2.97
(LLc/ABe)W	2.44	4.01	5.51	4.87	4.21
(LN)W	1.88	4.37	4.57	3.7	3.63
(LLN/Ln)W	1.67	3.82	3.3	1.38	2.54
(LC)W	3.7	4.77	3.65	3.97	4.02
(LLc/Lc)W	2.9	3.79	3.03	3.21	3.23
Mean	2.26	4.05	3.77	3.24	3.33

N	0	80	160	240	Mean
FYMRES					
none	2.24	4.32	3.77	3.00	3.33
FYM	2.28	3.79	3.76	3.48	3.33
Mean	2.26	4.05	3.77	3.24	3.33

	N	0	80	160	240
ROTATION	FYMRES				
(AO)W	none	1.55	2.58	1.3	2.43
	FYM	1.34	3.88	4.32	3.39
(ABe)W	none	1.56	4.23	3.5	3.41
	FYM	1.91	5.01	5.41	2.47
(LLn/AO)W	none	2.59	4.93	4.59	3.68
	FYM	2.01	2.69	1.04	2.23
(LLc/ABe)W	none	2.9	4.97	6.44	4.93
	FYM	1.99	3.05	4.57	4.81
(LN)W	none	2.2	4.4	4.92	3.36
	FYM	1.56	4.33	4.21	4.03

(LLN/Ln)W	none	1.23	3.94	2.39	1.57
	FYM	2.12	3.69	4.2	1.18
(LC)W	none	3.33	3.96	3.09	2.03
	FYM	4.07	5.57	4.21	5.91
(LLc/Lc)W	none	2.53	5.51	3.93	2.58
	FYM	3.27	2.08	2.12	3.84

Grain mean DM% 86.7

Plot area harvested 0.00183

WINTER RYE

Grain tonnes/hectare

Tables of means

FYMRES	none	FYM	Mean
ROTATION			
(AO)R	5.65	5.07	5.36
(ABe)R	4.44	5.15	4.80
(LLn/AO)R	5.34	4.47	4.90
(LLc/ABe)R	5.38	6.22	5.80
(Ln)R	4.40	5.40	4.90
(LLn/Ln)R	5.10	5.49	5.29
(Lc)R	6.19	5.31	5.75
(LLc/Lc)R	6.50	6.33	6.41
Mean	5.37	5.43	5.40

N	0	50	100	150	Mean
ROTATION					
(AO)R	2.99	5.50	6.34	6.61	5.36
(ABe)R	1.58	4.49	6.18	6.94	4.80
(LLn/AO)R	3.29	4.30	5.45	6.58	4.90
(LLc/ABe)R	3.88	5.78	6.45	7.09	5.80
(Ln)R	3.17	4.51	5.74	6.18	4.90
(LLn/Ln)R	3.41	5.31	5.83	6.62	5.29
(Lc)R	3.86	5.97	6.82	6.36	5.75
(LLc/Lc)R	4.62	6.04	7.66	7.33	6.41
Mean	3.35	5.24	6.31	6.71	5.40

N	0	50	100	150	Mean
FYMRES					
none	3.38	5.45	6.32	6.35	5.37
FYM	3.32	5.03	6.29	7.08	5.43
Mean	3.35	5.24	6.31	6.71	5.40

	N	0	50	100	150
ROTATION	FYMRES				
(AO)R	none	3.64	5.62	5.61	7.71
	FYM	2.34	5.38	7.06	5.50
(ABe)R	none	1.21	4.13	6.42	6.02
	FYM	1.94	4.86	5.93	7.87
(LLn/AO)R	none	4.06	5.70	4.81	6.79
	FYM	2.52	2.91	6.09	6.37
(LLc/ABe)R	none	3.88	5.83	6.42	5.40
	FYM	3.88	5.73	6.47	8.79
(Ln)R	none	2.81	3.61	5.92	5.25
	FYM	3.52	5.41	5.56	7.11
(LLn/Ln)R	none	2.95	5.17	6.47	5.80
	FYM	3.88	5.45	5.18	7.43
(Lc)R	none	4.08	7.36	6.80	6.54
	FYM	3.64	4.58	6.83	6.19
(LLc/Lc)R	none	4.42	6.20	8.10	7.26
	FYM	4.82	5.88	7.22	7.40

Grain mean DM%	87.14
Plot area harvested	0.00183

WINTER OATS

GRAIN (85% DRY MATTER) TONNES/HECTARE

Tables of means

FYMRES	NONE	FYM	Mean
ROTATION			
ABe	0.40	0.21	0.30
AO	2.04	1.86	1.95
LLc/ABe	2.40	1.26	1.83
LLn/AO	3.40	3.01	3.20
Mean	2.06	1.59	1.82

Grain mean DM%	88.4
Plot area harvested	0.00393

Note: Poor yields, probably due to summer drought.

18/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 54th year, Winter Rye.

For previous years see 'Details' 1973 and Yield Books for 74-17/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
16/05/2017	a	Powerharrowed	-	-
21/04/2017	f	Applied TSP (47% P_2O_5; Plots 001 - 004, 006 - 008, 009 - 010, 012 - 022, 024 - 025, 027 - 032	97.5	kg/ha
21/04/2017	f	Applied SOP (50% K_2O; 45% SO_3); Plots 001 - 004, 006 - 008, 009 - 010, 012 - 022, 024 - 025, 027 - 032	200	kg/ha
24/04/2017	f	Applied Compost; Plots 007, 012, 021, 027	40	t/ha
25/04/2017	f	Applied Farmyard Manure; Plots 008, 014, 018, 028	10	t/ha
25/04/2017	f	Applied Farmyard Manure; Plots 005, 011, 023, 026	25	t/ha

25/04/2017	f	Applied Chopped Wheat Straw; Plots 003, 015, 017, 031	7.5	t/ha
15/10/2017	a	Ploughed Plots - Thrown West	-	-
29/10/2017	a	Topped	-	-
17/11/2017	a	Completed Grass Yields	-	-
06/12/2017	a	Drilled Rye cv. Mephisto	300.00	seeds/m2
20/04/2018	a	Sprayed Chex; Rye Plots	250.00	ml/ha
20/04/2018	p	Sprayed Atlantis; Rye Plots	400.00	ml/ha
20/04/2018	p	Sprayed Hiatus; Rye Plots	50.00	gms/ha
20/04/2018	p	Sprayed Cogent; Rye Plots	1.00	lt/ha
30/04/2018	f	Applied Nitrochalk (27% N); Plots 0025, 0033, 0044, 0054, 0064, 0076, 0085, 0091, 0102, 0111, 0125, 0142, 0154, 0162, 0176, 0181, 0192, 0201, 0211, 0223, 0236, 0252, 0262, 0275, 0283, 0305, 0312, 0323	111.00	kg/ha
30/04/2018	f	Applied Nitrochalk (27% N); Plots 0023, 0034, 0042, 0051, 0061, 0074, 0086, 0094, 0103, 0114, 0123, 0141, 0152, 0165, 0172, 0183, 0191, 0204, 0216, 0221, 0234, 0254, 0264, 0273, 0281, 0306, 0316, 0321	222.00	kg/ha
30/04/2018	f	Applied Nitrochalk (27% N); 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	333.00	kg/ha
30/04/2018	f	Applied Nitrochalk (27% N); Plots 0024, 0032, 0045, 0053, 0065, 0073, 0084, 0093, 0106, 0116, 0126, 0146, 0155, 0164, 0171, 0185, 0193, 0202, 0215, 0226, 0235, 0256, 0266, 0272, 0282, 0304, 0311, 0325	444.00	kg/ha
30/04/2018	f	Applied Nitrochalk (27% N); Plots 0021, 0036, 0046, 0055, 0063, 0072, 0083, 0092, 0104, 0113, 0124, 0143, 0153, 0166, 0173, 0186, 0195, 0206, 0212, 0222, 0232, 0253, 0265, 0274, 0286, 0303, 0313, 0324	556.00	kg/ha

09/05/2018	p	Sprayed Sprinter; Rye Plots	2.00	lt/ha
09/05/2018	p	Sprayed Keystone; Rye Plots	500.00	ml/ha
09/05/2018	p	Sprayed Folicur; Rye Plots	800.00	ml/ha
09/05/2018	p	Sprayed Moddus; Rye Plots	100.00	ml/ha
09/05/2018	p	Sprayed Stefes CCC720; Rye Plots	2.00	lt/ha
05/06/2018	a	Topping - Surrounds or trials and Paths	-	-
13/06/2018	p	Spraying Sprinter	2.00	lt/ha
13/06/2018	p	Spraying Cello	630.00	ml/ha
20/06/2018	a	Topping	-	-
03/09/2018	a	Harvested all plots	-	-
07/09/2018	a	baled all remaining straw	-	-
12/09/2018	a	Topped Field	-	-

Yields

WINTER RYE

GRAIN TONNES/HECTARE (100% DM)
Tables of means

Nitrogen Treatment	0	30	60	90	120	150	Mean
F(Fd)	2.27	3.83	4.43	5.28	5.75	4.88	4.41
F(Ln, Lc6)	2.71	3.82	5.29	6.07	6.76	5.86	5.09
St(St)	2.23	3.78	4.58	5.39	6.28	5.29	4.59
CC(Gm, Lc8)	2.63	3.85	4.71	5.35	5.94	5.00	4.58
Co(Pt, Lc8)	4.12	4.92	5.77	6.00	6.68	6.33	5.64
Dg10(Fs)	3.14	3.99	5.58	5.96	6.40	6.37	5.24
Dg25(Dg)	4.54	6.35	6.45	7.13	6.94	6.88	6.38
Mean	3.09	4.36	5.26	5.88	6.40	5.80	5.13

Standard errors of differences of means

Table	Treatment	Nitrogen	Treatment Nitrogen
rep.	24	28	4
s.e.d.	0.279	0.136	0.432
d.f.	18	105	77.19
Except when comparing means with the same level(s) of			
Treatment	0.361		
d.f.	105		
Grain Mean DM (%)	84.8		

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
2018	2.98	0.93	3.91

Cut dry matter t/ha (10 JUL 2018 & 16 OCT 2018)

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

Weather Summaries

Rothamsted Research

The Weather : Monthly Summary : 2018

(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	64.9	(+2.83)	8.2	(+1.46)	2.2	(+0.96)	3.39	15	5.5	7.0	76.1	(+6.15)	23	56.9	11.0
February	116.6	(+36.29)	5.2	(-1.72)	-0.6	(-1.58)	-0.29	23	4.4	6.1	48.4	(-1.74)	16	22.5	9.8
March	87.4	(-27.51)	8.1	(-1.76)	1.7	(-0.98)	3.01	21	5.2	5.8	78.5	(+27.70)	25	68.5	9.8
April	128.2	(-33.05)	14.0	(+1.33)	6.7	(+2.63)	7.02	3	9.6	8.4	74.8	(+19.77)	17	67.8	8.8
May	267.2	(+72.55)	18.7	(+2.59)	7.9	(+1.00)	9.13	8	12.9	11.2	61.9	(+7.24)	13	11.3	7.2
June	266.2	(+68.03)	21.5	(+2.40)	10.9	(+1.11)	11.34	0	16.2	14.2	3.7	(-49.61)	7	0.5	7.4
July	294.4	(+89.18)	26.1	(+4.29)	13.8	(+1.92)	12.81	0	18.4	16.4	15.1	(-34.82)	6	0.2	6.4
August	172.9	(-23.35)	22.3	(+0.74)	12.5	(+0.69)	12.0	0	17.7	16.6	64.0	(+0.27)	13	1.1	6.2
September	188.2	(+44.77)	19.0	(+0.67)	9.2	(-0.69)	9.7	5	15.3	15.3	51.0	(-6.63)	12	10.4	7.4
October	141.1	(+29.34)	14.9	(+0.83)	6.9	(-0.21)	8.1	8	12.5	13.5	71.0	(-10.68)	18	32.5	7.8
November	80.9	(+10.11)	10.8	(+1.06)	4.9	(+1.13)	6.2	7	9.1	11.0	63.8	(-12.83)	21	36.4	8.1
December	57.0	(+3.21)	9.3	(+2.38)	3.7	(+2.01)	5.0	12	7.5	9.2	75.0	(+5.48)	21	58.8	8.5
Year	1864.7	(+272.39)	14.8	(+1.19)	6.6	(+0.67)	7.3	102.0	11.2	11.2	683.3	(-49.70)	192.0	366.9	8.2

* 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 : 2018

(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	57.6	(-2.47)	8.4	(+1.39)	2.4	(+1.19)	4.5	13	5.6	7.6	69.6	(+15.07)	25	10.5
February	105.7	(+30.76)	5.8	(-1.53)	-0.8	(-1.68)	1.0	23	4.6	6.8	29.8	(-12.36)	13	8.5
March	88.7	(-24.81)	8.7	(-1.63)	1.6	(-1.07)	4.1	21	5.5	6.3	82.0	(+36.09)	26	8.2
April	130.6	(-20.32)	14.1	(+1.07)	6.5	(+2.74)	8.3	3	10.2	8.1	87.4	(+35.19)	21	8.2
May	254.6	(+67.41)	19.2	(+2.63)	6.7	(+0.20)	10.3	8	13.9	10.8	70.4	(+17.14)	12	5.7
June	265.8	(+77.94)	21.9	(+2.40)	10.1	(+0.68)	13.1	0	17.9	13.9	4.2	(-45.87)	7	6.9
July	301.1	(+104.01)	26.5	(+4.43)	12.6	(+0.93)	12.1	0	20.8	16.4	14.6	(-35.29)	5	6.0
August	189.6	(+0.74)	22.8	(+0.89)	12.3	(+0.74)	12.1	0	19.0	17.4	54.2	(-3.60)	12	7.6
September	178.8	(+41.74)	19.6	(+0.93)	9.0	(-0.55)	9.9	5	15.7	16.1	34.4	(-22.71)	9	8.3
October	136.2	(+24.46)	15.4	(+0.93)	6.3	(-0.65)	8.4	11	12.4	14.1	71.8	(+0.97)	18	7.2
November	70.2	(+3.92)	11.3	(+1.32)	4.8	(+1.02)	6.3	10	8.8	11.5	40.4	(-22.07)	18	7.2
December	44.7	(-1.0)	9.7	(+2.5)	4.0	(+2.5)	5.2	10	7.5	9.7	62.6	(+6.8)	19	8.7
Year	1823.5	(+302.42)	15.4	(+1.29)	6.3	(+0.50)	8.0	104.0	11.9	11.6	621.4	(-30.60)	185.0	7.8

* 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