



**ROTHAMSTED
RESEARCH**

**Results of the
Classical and other
Long-term Experiments
2020**

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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, respectively.

Anhydrous Sulphate of Soda

Chalk

Compost

Double Top

27% N and 30% SO₃

FYM

Farmyard manure (from bullocks)

Headland Manganese 500

500 g/l 27.5% w/w MnCO₃

Kieserite

MgSO₄H₂O; 17.7% Mg and 23.3% S

Maize Tops

Magnesium sulphate

MgSO₄ H₂O ; 17.7% Mg and 23.3% S

Manganese sulphate

Mn₂ (SO₄)₃ ; 27% Mn and 24% S

Muriate of potash (MOP)

KCl ; 60% K₂O (49.8% K)

Nitram

34.5% N

Nitraprill

34.5% N

Nitrate of soda

NaNO₃ ; 16% N and 27% Na

Nitro-Chalk

Calcium Ammonium Nitrate ; 27% N

Silicate of soda

Na₂SiO₃ ; 37% Na and 23% Si

Sodium Sulphate

35% Na

Sulphate of ammonia	(NH ₄) ₂ SO ₄ ; 21% N and 24% S
Sulphate of potash (SOP)	K ₂ SO ₄ ; 50% K ₂ O (41.5% K) and 18.4% S
Triple superphosphate (TSP)	47% P ₂ O ₅ ; (20.1% P)

Cereal straw is removed unless otherwise stated.

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

PESTICIDES USED

The following list of pesticides is based on the HSE Pesticide Product Register (<https://secure.pesticides.gov.uk/pestreg/ProdSearch.asp>) and Adjuvant Product Register (<https://secure.pesticides.gov.uk/adjuvants/Search.aspx>); 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
Axial Pro	h	55 g/l pinoxaden
Azoxystar	f	250 g/l azoxystrobin
Buffalo Elite	ad	ammonium sulphate (40 % w/w), water conditioner
Caramba 90	f	90 g/l metconazole
Cello	f	prothioconazole + spiroxamine + tebuconazole (100:250:100 g/l)
Cyflamid	f	50 g/l cyflufenamid
Envoy	f	epoxiconazole + pyraclostrobin (62.5:85 g/l)
Firestarter	h	100 g/l diflufenican and 400 g/l flufenacet
Hallmark with Zeon Technology	i	lambda-cyhalothrin (100 g/l)
Laser	h	200 g/l cycloxydim
Liberator	h	100 g/l diflufenican and 400 g/l flufenacet
Nirvana	h	16.7 g/l imazamox and 250 g/l pendimethalin
Palio	h	1.4 % w/w florasulam and 7.1 % w/w pyroxsulam

Pontos	h	100 g/l picolinafen and 240 g/l flufenacet.
Presite SX	h	67 g/kg metsulfuron-methyl and 333 g/kg thifensulfuron-methyl
Samurai	h	360 g/l glyphosate, present as 441 g/l (35.3% w/w) of the potassium salt of glyphosate
SAN 703	f	375 g/l chlorothalonil and 40 g/l cyproconazole
Sprinter	h	700 g/l 2,4-D as the dimethylamine and the monomethylamine salts
Starane Hi-Load HL	h	333 g/l fluroxypyr
Starane XL	h	2.5 g/l florasulam and 100 g/l fluroxypyr
Stefes CCC 720	gr	720 g/l chlormequat
Troy 480	h	480 g/l (40.3% w/w) bentazone as the sodium salt
Velomax	ad	86.8 % w/w oil (rapeseed fatty acid esters), 5.2 % w/w alkoxyated alcohols, 2.5 % w/w oil (tall oil fatty acids)
Vortex	f	41.6 g/l epoxiconazole, 41.6 g/l fluxapyroxad and 61.0 g/l pyraclostrobin

Machinery Referred to in the Diary Notes

<u>Cultivators</u>	<u>Manufacturer</u>	<u>Width</u>	<u>Description</u>
Plough	Kverneland	1.5 m	5 Furrow, 25 cm Furrows.
Plough	Ransome	1 m	3 Furrow, 25 cm Furrows
Plough	Dowdeswell		5 furrow, 12 in Furrows (Woburn)
Press	Philip Watkins	4.6 m	Used to level and consolidate ground after ploughing
Flexitine	Bomford	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.
<u>Drills</u>	<u>Manufacturer</u>	<u>Width</u>	<u>Description</u>
Accord Combination Drill No. 4	Kverneland	3.0 m	Power-harrow mounted pneumatic drill with Suffolk coulters 12.5 cm apart.
Accord Tyne Drill	Kverneland	4.0 m	3 point linkage with Suffolk coulters Plots/Commercial (Woburn)

<u>Chemical Applicators</u>	<u>Manufacturer</u>	<u>Width</u>	<u>Description</u>
Cascade	Horstine	12 m	Tractor mounted pneumatic boom fertiliser spreader
GSA 300	Nordsten	3 m	Tractor mounted - Fert Applications.
Exactomatic	Ransome, Nordsten	3.8 m	Tractor mounted - Fert Applications.
Muck Spreader	International	1.5 m	Trailed - FYM Applications.
Sprayer	Tecnoma	12 m	Tractor mounted boom sprayer - Chemical Application.
Sprayer	Knight	24 m	Tractor mounted boom sprayer - Chemical Application.
Sprayer	Knight	12 m	Tractor mounted boom sprayer - Chemical Application. (Woburn)

<u>Harvesters</u>	<u>Manufacturer</u>	<u>Width</u>	<u>Description</u>
Tucano 430	Claas	6 m	Commercial combine used for harvesting discards after plot yields.
Box Mower	Wilder	1.01 m	Box mower mainly used for yields on PG/5.
Mower	Unifarm	1.83 m	Commercial mower used to mow discards on PG/5.
Mower Conditioner	Kuhn	3 m	Commercial mower with conditioning.
Plot Combine	Haldrup	2 m Cut	Cereal plot combine harvester (used 2017 Onward).

<u>Other</u>	<u>Manufacturer</u>	<u>Width</u>	<u>Description</u>
Cambridge Ring Rolls	Flexicoil	6 m	Ring rolls for covering seed post drilling.
PZ Hay Rake	Zweegers	-	Rowing up for baling
Tedder (Fanex 524)	Vicon	-	Turning and rowing up of grass for hay making (W/RN/3 and 12, R/PG/5).
Topper 9	McConnell	2.72 m	Topper used for topping stubbles and grass areas.
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.

Grass Box Wilder - Used for Grass Weights.

<u>Tractors</u>	<u>Manufacturer</u>	<u>Weight</u>	<u>Description</u>
ISTH4335	Iseki	1.71 t	Small Machinery Tractor
JD5070	John Deere	5.85 t	Wide Wheeled Tractor
JD5620	John Deere	5.46 t	Drilling Tractor
JD6145R	John Deere	11.25 t	Cultivations Tractor
JD6230	John Deere	6.10 t	Yard Tractor
JD6620	John Deere	5.2 t	Tractor (Woburn)
JD6830	John Deere	5.7 t	Fertiliser Tractor
JD6930	John Deere	5.9 t	Drilling Tractor
MF3070	Massey Ferguson	4.4 t	Hedge Cutting Tractor
MF6150	Massey Ferguson	4.6 t	Spraying Tractor (Woburn)
NH T6030	New Holland	5.50 t	Mounted Sprayer Tractor
NH T7210	New Holland	8.10 t	Cultivations Tractor
Tym T503	Tym	3.63 t	Small Light Tractor

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

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

20/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.

2020 was the 177th year of the experiment, 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 74-19/R/BK/1.

Areas harvested ^a:

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

^aThe new Haldrup combine has a slightly smaller cut width (2.0 m) than the previous Sampo combine (2.1 m). Consequently, from 2017 cereal yields were based on a 2.0 m cut width.

Treatments:

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

Whole plots

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

15 N5(P)KMg	15	N5 (P) K Mg
16 N6(P)KMg	16	N6 (P) K Mg
17 N1+4+1PKMg	17	N1+4+1 P K Mg
18 N1+2+1PKMg	18	N1+2+1 P K Mg
19 N1+1+1KMg	19	N1+1+1 K Mg
20 N4KMg	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.

– 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 35 t/ha (fresh wt). Oats received no N or FYM from 1996 to 2017.

Winter Beans (Be) No 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 2020.

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 2020

FYM: Farmyard manure at 35 t

Previous treatment:

Whole plots

PLOT

Plot	Fertilizers and organic manures:-		
	Treatments until 1967	Treatments from 1968	Treatments from 1985 – 2000
01 DN4PK	01 -	D N2 P K	D N4 P K
2.1 DN2	21 D	D N2	D N2
2.2 D	22 D	D	D
03 0	03 None	None	None
05 F	05 P K Na Mg	P K (Na) Mg	PK Mg
06 N1F	06 N1 P K Na Mg	N1 P K (Na) Mg	N1 P K Mg
07 N2F	07 N2 P K Na Mg	N2 P K (Na) Mg	N2 P K Mg
08 N3F	08 N3 P K Na Mg	N3 P K (Na) Mg	N3 P K Mg
09 N4F	09 N*1 P K Na Mg	N4 P K (Na) Mg	N4 P K Mg
10 N2	10 N2	N2	N2

11 N2P	11	N2 P	N2 P	N2 P
12 N2PNA	12	N2 P Na	N2 P Na	N2 P Na
13 N2PK	13	N2 P K	N2 P K	N2 P K
14 N2PKMG	14	N2 P Mg	N2 P K Mg	N2 P K Mg
15 N5F	15	N2 P K Na Mg	N3 P K(Na) Mg	N5 P K Mg
16 N6F	16	N*2 P K Na Mg	N2 P K (Na) Mg	N6 P K Mg
17 N1+3FH	17	N2 (A)	N2 ½[P K (Na) Mg]	N1+3 ½[P K Mg] (A)+
18 N0+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)
20 N2KMG	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[P K 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: 30 kg 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
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
2019	W	W	W	W	W	O	W	W	W	Be
2020 ^{++,†}	W	W	W	W	W	W	O	W	Be	W

W = winter wheat, O = winter oats, P = potatoes, BE = spring beans, F = fallow, M = forage maize, Be = Winter Beans

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

+ No herbicides.

⁺⁺ Spring Wheat in 2015, 2020

[†] Spring Oats in 2001, 2020

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. Spring wheat (var Tybalt) was sown in March 2020 because the wet autumn and winter of 2019-2020 prevented sowing of a winter crop.
- (6) Section 8 was left in bare fallow in 2015 & 2016 and had two in-season cultivations (inversion ploughing) each year to control weeds.

20/R/BK/1 Experimental Diary:

Date		Application	Rate	Unit
All Sections				
13/09/2019	p	Sprayed Buffalo Elite; NH T6030 with Knight Sprayer; Tank volume 200 l	1	l/ha
13/09/2019	p	Sprayed Samurai; NH T6030 with Knight Sprayer; Tank volume 200 l	4	l/ha
18/09/2019	f	Applied MOP muriate of potash; Strip 14; All Sections; JD6930 with Cascade Spreader	181	kg/ha
18/09/2019	f	Applied TSP triple superphosphate; Strips 11, 13, 14, 17, 18; All Sections; JD6930 with Cascade Spreader	171	kg/ha
23/09/2019	a	Ploughed; Thrown North; NHT7210 with KV Five Furrow Plough		
23/09/2019	f	Applied FYM Strips 2.1, 2.2; All Sections; Tym T503 with Muck spreader - international	35	t/ha

23/03/2020		Cultivation: Done to break up ploughed ground in the spring so it dries before drilling - Section 8 done twice		
27/03/2020	a	Rolled; JD5620 with 6m Flexicoil Cambridge Roll		
25/06/2020	f	Applied Kieserite (15% Mg) ; Strips 05, 06 ,07, 08, 09, 11, 12, 15, 16, 17, 18, 19; All Sections	80	kg/ha
02/07/2020	a	Power Harrowed; JD6145R with Kuhn Powerharrow 3m		
16/07/2020	f	Applied SOP (50% K2O) ; Strips 05, 06 ,07, 08, 09, 12, 13, 15, 16, 17, 18, 19; All Sections	217	kg/ha

S WHEAT

25/03/2020	s	Drilled Spring Wheat, var: Tybalt; Sections 0, 1, 2, 5, 6, 7, 8, 9; JD6830	350	seeds/m ²
12/05/2020	f	Applied Nitram ; Strips 12, 17, 18, 19; excludes Sections 3, 4; JD6930 with Cascade Spreader	139	kg/ha
19/05/2020	p	Sprayed Cello; Tym T503 with Tecnomia Sprayer	1	l/ha
19/05/2020	p	Sprayed Stefes CCC 72; Tym T503 with Tecnomia Sprayer	1	l/ha
20/05/2020	f	Applied Nitram; Strips 06, 19; excludes Sections 3, 4; JD6930 with Cascade Spreader	139	kg/ha
20/05/2020	f	Applied Nitram; Strips 07, 18; excludes Sections 3, 4; JD6930 with Cascade Spreader	278	kg/ha
20/05/2020	f	Applied Nitram; Strips 2.1, 08, 12; excludes Sections 3, 4; JD6930 with Cascade Spreader	417	kg/ha
20/05/2020	f	Applied Nitram; Strips 01, 09, 10, 11, 13, 14, 17; excludes Sections 3, 4; JD6930 with Cascade Spreader	556	kg/ha
20/05/2020	f	Applied Nitram; Strip 15; excludes Sections 3, 4; JD6930 with Cascade Spreader	696	kg/ha
20/05/2020	f	Applied Nitram; Strip 16; excludes Sections 3, 4; JD6930 with Cascade Spreader	835	kg/ha
20/05/2020	p	Sprayed Axial Pro; NH T6030 with Knight Sprayer	60	ml/ha
20/05/2020	p	Sprayed Presite SX; NH T6030 with Knight Sprayer	60	g/ha
20/05/2020	p	Sprayed Starane; NH T6030 with Knight Sprayer	0.4	l/ha
20/05/2020	p	Sprayed Stefes CCC 72; NH T6030 with Knight Sprayer	1	l/ha
21/05/2020	f	Applied Nitram; Strip 2.1; excludes Sections 3, 4; JD5070 with Exactomatic	417	kg/ha
21/05/2020	p	Sprayed Axial Pro; NH T6030 with Knight 24m Sprayer	0	l/ha
21/05/2020	p	Sprayed Cello; NH T6030 with Knight 24m Sprayer	1	l/ha
21/05/2020	p	Sprayed Presite SX; NH T6030 with Knight 24m Sprayer	60	g/ha
21/05/2020	p	Sprayed Starane; NH T6030 with Knight 24m Sprayer	0.4	l/ha
21/05/2020	p	Sprayed Stefes CCC 72; NH T6030 with Knight 24m Sprayer	1	l/ha
08/06/2020	f	Applied Nitram; JD6930 with Cascade Spreader	139	kg/ha
08/06/2020	f	Applied Nitram; Strips 12, 17, 18, 19; excludes Sections 3, 4; JD6930 with Cascade Spreader	139	kg/ha
25/06/2020	p	Sprayed Cello; NH T6030 with Knight 24m Sprayer	1	l/ha

25/06/2020	p	Sprayed Envoy; NH T6030 with Knight 24m Sprayer	0.203	l/ha
17/07/2020	a	hand Weeded Wild Oats; Plot 108; 9 Plants; By Hand		
07/09/2020	a	Harvest Odds and Ends; Section 0 (chopped straw onto plot area), Section 1 and Section 2; Haldrup C-85		
07/09/2020	a	Harvest Wheat plots; Haldrup C-85		

S OATS

13/09/2019	p	Sprayed Buffalo Elite; NH T6030 with Knight Sprayer; Tank volume 200 l	1	l/ha
13/09/2019	p	Sprayed Samurai; NH T6030 with Knight Sprayer; Tank volume 200 l	4	l/ha
26/03/2020	s	Drilled Spring Oats, var: Elyann; Section 3; JD6830 with Accord Combination Drill No. 4	350	seeds/m ²
20/05/2020	f	Applied Nitram; Strip 06; Section3; JD6930 with Cascade Spreader	70	kg/ha
20/05/2020	f	Applied Nitram; Strip 07; Section3; JD6930 with Cascade Spreader	139	kg/ha
20/05/2020	f	Applied Nitram; Strips 2.1, 08, 19; Section3; JD6930 with Cascade Spreader	209	kg/ha
20/05/2020	f	Applied Nitram; Strips 01, 09, 10, 11; Section3; JD6930 with Cascade Spreader	278	kg/ha
20/05/2020	f	Applied Nitram; Strips 12, 15; Section3; JD6930 with Cascade Spreader	348	kg/ha
20/05/2020	f	Applied Nitram; Strips 16, 17; Section3; JD6930 with Cascade Spreader	417	kg/ha
21/05/2020	f	Applied Nitram by hand to plot 2.13 only (Spring oats - section 3); By Hand	209	kg/ha
21/05/2020	p	Sprayed Cyflamid; Tym T503 with Tecnomia Sprayer	0.1	l/ha
21/05/2020	p	Sprayed Envoy; Tym T503 with Tecnomia Sprayer	0.8	l/ha
21/05/2020	p	Sprayed Stefes CCC 72; Tym T503 with Tecnomia Sprayer	1	l/ha
24/06/2020	p	Sprayed Cello; NH T6030 with Knight Sprayer	0.6	l/ha
01/09/2020	a	Harvest Oats; Section 3; Haldrup C-85		

W BEANS

13/09/2019	p	Sprayed Buffalo Elite; NH T6030 with Knight Sprayer; Tank volume 200 l	1	l/ha
13/09/2019	p	Sprayed Samurai; NH T6030 with Knight Sprayer; Tank volume 200 l	4	l/ha
26/03/2020	s	Drilled Winter Beans, var: Tundra; Section 4; Accord Combination Drill No. 4	35	seeds/m ²
01/04/2020	p	Sprayed Nirvana; NH T6030 with Knight Sprayer	4.5	l/ha
01/04/2020	p	Sprayed Velomax; NH T6030 with Knight Sprayer	0.4	l/ha
27/04/2020	p	Sprayed Hallmark with Zeon Technology; NH T6030 with Knight Sprayer	75	ml/ha
07/07/2020	p	Sprayed Caramba 9; NH T6030 with Knight Sprayer	0.8	l/ha
06/09/2020	a	Harvest Beans; Section 4; Haldrup C-85		

WILDERNESS

23/12/2019	a	Topped: stubbed area
16/03/2020	a	Topped: mown area
05/05/2020	a	Topping: mown area
17/06/2020	a	Topping: mown area
05/08/2020	a	Topping: mown area
12/10/2020	a	Topping: mown area

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	5/W1	7/W2	6/W43	0/W16	1/W54	9/W62	8/W4	Mean
01 (FYM)N4	6.98	7.34	7.36	5.47					6.79
2.1 FYMN3	7.85	8.63	8.38	5.73	5.77	7.25	6.98	3.99	6.82
2.2 FYM	8.63	7.21	6.48	5.97	5.82	6.78	6.74	3.56	6.40
03 Nil	2.29	1.49	0.70	1.18	0.60	0.52	0.39	2.02	1.15
05 (P)KMg	3.72	1.69	1.81	1.03	1.25	1.13	0.74	3.36	1.84
06 N1(P)KMg	5.20	3.64	3.96	2.67	4.57	3.68	3.84	3.52	3.89
07 N2(P)KMg	6.08	4.90	4.89	4.23	5.18	5.54	4.85	3.84	4.94
08 N3(P)KMg	6.02	5.40	5.52	4.65	5.41	5.30	5.36	4.26	5.24
09 N4(P)KMg	6.22	5.76	5.66	5.50	5.79	5.41	5.45	3.98	5.47
10 N4	3.26	4.27	2.42	3.25	1.72	1.16	1.62	2.40	2.51
11 N4PMg	4.52	4.27	4.32	4.39	5.37	4.48	3.60	3.07	4.25
12 N1+3+1(P)KMg	6.58	5.98	5.99	6.01	5.72	5.48	5.92	4.01	5.71
13 N4PK	6.22	5.90	6.35	6.32	6.13	5.65	5.40	3.72	5.71
14 N4PK*(Mg*)	6.14	5.51	6.56	6.24	6.03	5.40	5.30	3.77	5.62
15 N5(P)KMg	6.37	5.71	6.45	5.86	5.66	5.63	5.09	3.54	5.54
16 N6(P)KMg	6.07	6.56	6.03	5.70	5.60	5.15	5.28	3.28	5.46
17 N1+4+1PKMg	6.65	6.40	6.62	6.48	5.65	5.72	5.79	4.08	5.92
18 N1+2+1PKMg	7.35	6.46	6.35	5.61	5.96	5.30	5.15	4.35	5.82
19 N1+1+1KMg	6.70	4.45	4.83	4.57	4.24	3.68	4.76	4.17	4.67
20 N4KMg					0.71	0.30			0.51
Mean	5.94	5.35	5.30	4.78	4.59	4.40	4.57	3.61	4.83
Grain Mean DM%	82.8								

Straw Tonnes/Hectare

Tables of means

SECTION PLOT	2/W1	5/W1	7/W2	6/W43	0/W16	1/W54	9/W62	8/W4	Mean
01 (FYM)N4	2.13	2.10							2.11
2.1 FYMN3	2.68	3.05				2.23		5.83	3.45
2.2 FYM	3.13	2.03				2.64		2.53	2.58
03 Nil	0.31	0.08				0.09		0.42	0.23
05 (P)KMg	0.87	0.09				0.14		1.39	0.62
06 N1(P)KMg	1.26	0.81				1.02		1.85	1.24
07 N2(P)KMg	1.83	1.50				1.48		1.75	1.64
08 N3(P)KMg	1.44	1.50				1.62		2.27	1.70
09 N4(P)KMg	1.77	1.64				1.56		2.79	1.94
10 N4	0.63	0.81				0.11		0.79	0.59
11 N4PMg	1.01	0.95				0.94		1.51	1.10
12 N1+3+1(P)KMg	2.07	2.12				1.56		3.91	2.42
13 N4PK	1.92	1.92				2.01		3.81	2.42
14 N4PK(Mg)	1.53	1.69				1.37		1.99	1.64
15 N5(P)KMg	1.94	1.83				1.63		3.59	2.25
16 N6(P)KMg	1.28	2.20				1.52		3.06	2.02
17 N1+4+1PKMg	1.93	2.05				1.74		3.03	2.19
18 N1+2+1PKMg	2.11	1.91				1.57		2.44	2.01
19 N1+1+1KMg	1.71	0.99				1.06		1.55	1.33
20 N4KMg						0.06			0.06
Mean	1.66	1.54				1.28		2.47	1.73
Straw Mean DM%	87.8								

SPRING OATS

Tonnes/Hectare (85% DM)

Table of means

Plot	Treatment	Grain	Straw
013	01 (FYM)1/2N4	4.96	2.22
213	2.1 FYM 1/2N3	5.97	3.12
223	2.2 FYM	6.13	2.34
033	03 Nil	1.30	0.18
053	05 (P)KMg	1.65	0.20
063	06 1/2N1(P)KMg	2.78	0.93
073	07 1/2N2(P)KMg	3.25	1.44
083	08 1/2N3(P)KMg	3.30	1.51
093	09 1/2N4(P)KMg	3.44	1.57
103	10 1/2N4	1.89	0.58
113	11 1/2N4 PMg	4.26	1.17
123	12 1/2N5(P)KMg	4.16	2.24
133	13 1/2N4 PK	4.18	2.07
143	14 1/2N4PK*(Mg*)	3.67	1.94
153	15 1/2N5(P)KMg	3.26	2.04

163	16 1/2N6(P)KMg	3.23	1.85
173	17 1/2N6 PKMg	3.37	1.78
183	18 1/2N4 PKMg	3.36	1.71
193	19 1/2N3 KMg	2.60	0.99
	Mean	3.51	1.57
	Mean DM%	85.4	87.0
	Plot Area Harvested (ha)	0.00463	

WINTER BEANS

TONNES/HECTARE (85% DM)

Tables of means

Plot	Treatment	Grain	Straw
014	01 (FYM)[N4]	4.34	1.30
214	21 [FYMN3]	5.12	2.01
224	22 [FYM]	5.50	2.25
034	03 Nil	0.83	0.29
054	05 (P)KMg	1.63	0.09
064	06 [N1](P)KMg	3.03	0.76
074	07 [N2](P)KMg	3.58	1.36
084	08 [N3](P)KMg	3.75	1.00
094	09 [N4](P)KMg	3.63	0.76
104	10 [N4]	0.91	0.33
114	11 [N4]PMg	0.14	0.14
124	12 [N1+3+1](P)KMg	2.69	0.51
134	13 [N4]PK	3.39	0.51
144	14 [N4]PK*(Mg*)	3.28	0.81
154	15 [N5](P)KMg	2.96	0.60
164	16 [N6](P)KMg	2.61	0.34
174	17 [N1+4+1]PKMg	3.31	0.55
184	18 [N1+2+1]PKMg	3.85	0.66
194	19 [N1+1+1]KMg	2.60	0.66
	MEAN	3.01	0.79
	Mean DM%	83.6	83.3
	PLOT AREA HARVESTED (ha)	0.00463	

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

YEAR	2020
SECTION	8/W4
PLOT	
01 (FYM) N4	-
2.1 FYMN3	3.86
2.2 FYM	3.43
03 Nil	1.87
05 (P)KMg	3.02
06 N1(P)KMg	3.14
07 N2(P)KMg	3.41
08 N3(P)KMg	3.55
09 N4(P)KMg	3.36
10 N4	2.20
11 N4PMg	2.48
12 N1+3+1(P)K2Mg2	3.31
13 N4PK	2.99
14 N4PK*(Mg*)	3.22
15 N5(P)KMg	2.86
16 N6(P)KMg	2.60
17 N1+4+1PKMg	3.59
18 N1+2+1PKMg	3.81
19 N1+1+1KMg	3.71
20 N4KMg	-
Mean	3.13

Note: All clean grain yields for section 8 are reported for the 2.0 - 3.5 mm grain size fraction, excluding grain <2 mm, as was the practice prior to 2012.

20/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 169th year, spring barley.

For previous years see 'Details' 1967 and 1973, Station Report for 1966 and Yield Books for 74-19/R/HB/2.

Main plots**Treatments:****Whole plots**

MANURE	Plot	Form of N 1852-1966	Fertilizers and Organic Manures:-	
			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 48 kg 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 2021

P2: 44 kg P as triple superphosphate since 2001

K: 90 kg K as sulphate of potash

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

Mg: 35 kg 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 35 t since 1852

D2001: Farmyard manure at 35 t 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 48 kg 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, 144 kg as "Nitro-chalk" since 2003

Si: Silicate of soda at 450 kg (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 (Strip 5 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, 144 kg as "Nitro-chalk"

K: 90 kg K as sulphate of potash

K*: 450 kg 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
18/09/2019	f Applied TSP; Plots 631, 632, 633 and 634; JD6930 with Cascade Spreader	215	kg/ha
18/09/2019	f Applied Kieserite; Plots 631, 632, 633 and 634; By Hand	233	kg/ha
20/09/2019	f Applied Silicate of Soda; Plots 132, 133, 232, 233, 332, 333, 432, 433; JD6930 with Cascade Spreader	450	kg/ha
20/09/2019	f Applied SOP (50% K2O5); Plots 311-314, 411-414, 321-324, 421-424, 331-334, 431-434, 631-634, 141-144, 241-244, 341-344, 441-444, 551, 552, 561, 562, 571, 572, 581, 582; JD6930 with Cascade Spreader	217	kg/ha
23/09/2019	f Applied FYM; Plots 734, 733, 732, 731, 724, 723, 722, 721; Tym T503 with Muck spreader	35	t/ha
21/11/2019	a Ploughing. Headlands; Direction thrown: S; NHT7210 with KV Five Furrow Plough	-	-
16/03/2020	p Sprayed Buffalo Elite; NH T6030 with Knight Sprayer	1	l/ha
16/03/2020	p Sprayed Samurai; NH T6030 with Knight Sprayer	3	l/ha
24/03/2020	s Drilled spring barley, var: Diablo; JD6830 with Accord Combination Drill No. 4	350	seeds/m ²
25/03/2020	a Rolled; JD5620 with 6m Flexicoil Cambridge Roll	-	-
04/05/2020	f Applied Nitro-chalk (27% N); Plots 111, 121, 214, 221, 311, 322, 413, 423, 614, 623, 633, 713, 724, 734; By Hand; By Hand	48	kg/ha
04/05/2020	f Applied Nitro-chalk (27% N); Plots 113, 124, 211, 222, 313, 321, 412, 421, 611, 621, 631, 712, 721, 732; By Hand; By Hand	96	kg/ha
04/05/2020	f Applied Nitro-chalk (27% N); Plots 112, 123, 212, 223, 314, 324, 414, 422, 613, 624, 634, 711, 722, 731; By Hand; By Hand	144	kg/ha
12/05/2020	f Applied Nitram; to Series AA, Series C, strip 5 and commercial surrounds (not applied to plots 631, 632, 633, 634, 731, 732, 733, 734); By Hand; JD6930 with Cascade Spreader	417	kg/ha
14/05/2020	p Sprayed Axial Pro; NH T6030 with Knight Sprayer	0.6	l/ha
14/05/2020	p Sprayed Cello; NH T6030 with Knight Sprayer	1	l/ha
14/05/2020	p Sprayed Presite SX; NH T6030 with Knight Sprayer	60	g/ha
14/05/2020	p Sprayed Starane; NH T6030 with Knight Sprayer	0.4	l/ha

23/06/2020	p	Sprayed Cello; NH T6030 with Knight Sprayer	0.6	l/ha
20/07/2020	a	Hand Weeding of 2 Wild Oats	-	-
01/09/2020	a	Harvest; Haldrup C-85	-	-
01/09/2020	a	Harvest strip next to yield strip to allow baler to bale swaths for straw weights; Haldrup C-85 2m cut	-	-
02/09/2020	a	Straw Weights; Tym T503 with New Holland Baler	-	-
02/09/2020	a	Harvesting, Commercial; Claas Tucano 430	-	-
06/09/2020	a	Baling; JD6830 with Claas Baler	-	-

Yields

Main Plots

Grain Yield, tonnes/hectare

Table of means

	N	0	48	96	144	Mean
MANURE						
---	0.63	0.96	0.72	0.73	0.76	0.76
-P-	1.99	2.02	3.06	3.08	2.54	2.54
--K	0.91	1.30	1.19	1.35	1.19	1.19
-PK	1.72	2.55	3.69	3.64	2.90	2.90
A--	0.47	0.75	1.00	0.90	0.78	0.78
AP-	2.28	2.82	3.00	2.96	2.77	2.77
A-K	0.72	0.83	0.93	1.01	0.87	0.87
APK	1.48	2.46	3.32	3.47	2.68	2.68
FYM1852onwards	5.92	6.70	6.38	6.73	6.43	6.43
FYM1852-1871	2.59	1.95	1.75	1.50	1.95	1.95
(A)	0.99	0.88	0.99	1.63	1.12	1.12
-	0.86	0.75	1.00	0.91	0.88	0.88
FYM2001onwards	4.51	5.70	5.65	6.01	5.47	5.47
P2K	2.06	2.13	3.69	3.34	2.80	2.80
Mean	1.94	2.27	2.60	2.66	2.37	2.37
Grain mean DM%	86.9					

Straw Yield, tonnes/hectare

Table of means

	N	0	48	96	144	Mean
MANURE						
---	0.11	0.32	0.22	0.11	0.19	
-P-	0.36	0.47	0.98	0.71	0.63	
--K	0.17	0.24	0.13	0.25	0.20	
-PK	0.47	0.52	0.77	0.93	0.67	
A--	0.07	0.21	0.20	0.26	0.18	
AP-	0.39	0.58	0.74	0.66	0.59	
A-K	0.10	0.16	0.19	0.27	0.18	
APK	0.33	0.54	0.81	0.78	0.62	
FYM1852onwards	1.70	2.21	1.83	2.49	2.06	
FYM1852-1871	0.73	0.48	0.45	0.28	0.49	
(A)	0.25	0.29	0.22	0.41	0.29	
-	0.26	0.23	0.23	0.24	0.24	
FYM2001onwards	1.61	1.73	1.83	1.65	1.70	
P2K	0.53	0.18	0.50	0.73	0.49	
Mean	0.51	0.58	0.65	0.70	0.61	
Straw mean DM%	86.3					
Plot Area (ha)	0.00244	0.00183				

PHOSPHATE PLOTS**Grain Yield, tonnes/hectare***Tables of means***PLOTS**

142	2.07
143	2.02
144	1.51
242	4.56
243	4.52
244	4.41
341	2.06
342	2.55
343	3.20
344	3.89
441	3.27
442	3.93
443	3.57
444	4.25

551	4.86
552	4.42
561	4.75
562	4.56
571	3.20
572	3.54
581	0.66
582	0.70
Mean	3.30

Grain Mean DM%	86.5
Plot area Harvested (ha)	0.00244

SILICATE PLOTS

Grain Yield, tonnes/hectare

Tables of means

	PK	N3--	N3P-	N3-K	N3PK	Mean
Silicate						
(-)-	-		3.90	1.04	3.68	2.15
(Si)-	1.11		3.51	1.70	4.05	2.59
(-)Si	1.88		3.78	1.46	4.71	2.96
(Si)Si	1.79		3.70	1.75	4.40	2.91
Mean	1.59		3.72	1.49	4.21	2.65
Grain Mean DM%	86.6					
Plot area harvested (ha)	0.00244					

Means exclude missing values

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

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

Whole plot dimensions: 9 m × 211 m

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. Nevertheless, the experiment is in its 165th year. For previous years see 'Details' 1967, 1973 and Yield Books for 74-19/R/WF/3.

Experimental Diary

Date	Application	Rate	Units
26/09/2019	a Ploughing; Direction thrown: S; NHT7210 with KV Five Furrow Plough	-	-
27/09/2019	a Press ploughing; JD6145R with Philip Watkins Press	-	-
23/03/2020	a Cultivation; JD6830 with Bomford Flexitine	-	-
24/03/2020	a Drilled spring wheat, var: Tybalt; JD6830 with Accord Combination Drill No. 4	350	seeds/m ²
15/05/2020	p Sprayed Axial Pro; NH T6030 with Knight Sprayer	0.6	l/ha
15/05/2020	p Sprayed Cello; NH T6030 with Knight Sprayer	1	l/ha
15/05/2020	p Sprayed Presite SX; NH T6030 with Knight Sprayer	60	g/ha
15/05/2020	p Sprayed Starane; NH T6030 with Knight Sprayer	0.4	l/ha
15/05/2020	p Sprayed Stefes CCC 72; NH T6030 with Knight Sprayer	1	l/ha
19/05/2020	f Applied Nitram; JD6930 with Cascade Spreader	146	kg/ha
26/06/2020	p Sprayed Cello; NH T6030 with Knight Sprayer	1	l/ha
26/06/2020	p Sprayed Envoy; NH T6030 with Knight Sprayer	0.203	l/ha
31/08/2020	a Harvested all plots; Claas Tucano 430	-	-

20/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 165th year, winter wheat.

For previous years see 'Details' 1977, 1973 and Yield Books for 74-19/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 K ₂ O (62.2 kg K)
	K2	150 kg K ₂ O (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	Unit
18/09/2019	f	Applied triple superphosphate; Plots 011, 012, 021- 024, 031, 032, 041-044, 051, 052, 061-064, 071, 072, 081-084, 091, 092, 101-104; JD6930 with Cascade Spreader	75	kg/ha
18/09/2019	f	Applied muriate of potash; Plots 023, 043, 063,083, 103; JD6930 with Cascade Spreader	125	kg/ha
18/09/2019	f	Applied muriate of potash; Plots 011-014, 024, 031-034, 044, 051-054, 064, 071-074,084, 091-094, 104; JD6930 with Cascade Spreader	250	kg/ha
26/09/2019	a	Ploughing; Thrown S; KV Five Furrow Plough with NHT7210	-	-
27/09/2019	a	Press ploughing; JD6145R with Philip Watkins Press	-	-
23/03/2020	a	Cultivation; JD6830 with Bomford Flexitine	-	-
24/03/2020	s	Drilled spring wheat, var: Tybalt; JD6830 with Accord Combination Drill No. 4	350	seeds/m ²
15/05/2020	p	Sprayed Axial Pro; NH T6030 with Knight Sprayer	0.6	l/ha
15/05/2020	p	Sprayed Cello; NH T6030 with Knight Sprayer	1	l/ha
15/05/2020	p	Sprayed Presite SX; NH T6030 with Knight Sprayer	60	g/ha
15/05/2020	p	Sprayed Starane; NH T6030 with Knight Sprayer	0.4	l/ha
15/05/2020	p	Sprayed Stefes CCC 72; NH T6030 with Knight Sprayer	1	l/ha
20/05/2020	f	Applied ammonium sulphate (21% N 60% SO ₃); JD6930 with Cascade Spreader	238	kg/ha
08/06/2020	f	Applied Nitram (34.5% N); JD6930 with Cascade Spreader	580	kg/ha
11/06/2020	f	Applied Nitram (34.5% N); JD6930 with Cascade Spreader	145	kg/ha

26/06/2020	f	Applied Kieserite; JD6930 with Cascade Spreader	80	kg/ha
26/06/2020	p	Sprayed Cello; NH T6030 with Knight Sprayer	1	l/ha
26/06/2020	p	Sprayed Envoy; NH T6030 with Knight Sprayer	0.2	l/ha
07/09/2020	a	Harvest Plots; Haldrup C-85	-	-
07/09/2020	a	Harvest odds and ends; Haldrup C-85	-	-
09/09/2020	a	Baled off all straw; JD6230 with Claas Baler	-	-
10/09/2020	a	Straw Weights; Tym T503 with New Holland Baler	-	-

Yields

P TEST

Grain Yield, tonnes/hectare

Tables of means

P_RES	O	(P1)	(P2)	(P3)	Mean
OLD_RES					
O	1.61	2.83	3.23	3.49	2.79
D	2.36	4.09	4.89	4.62	3.99
N	1.37	2.61	3.60	4.10	2.92
P	2.53	4.03	5.07	4.60	4.06
NPKNAMG	1.88	3.49	4.33	4.17	3.47
Mean	1.95	3.41	4.22	4.20	3.45

Grain mean DM% 84.2

Straw Yield, tonnes/hectare

Tables of means

P_RES	O	(P1)	(P2)	(P3)	Mean
OLD_RES					
O	0.56	0.93	1.04	0.98	0.88
D	0.76	1.22	1.39	1.34	1.18
N	0.40	0.82	1.02	1.01	0.81
P	1.22	1.08	1.45	1.23	1.25
NPKNAMG	0.71	0.99	1.16	1.14	1.00
Mean	0.73	1.01	1.21	1.14	1.02

Straw mean DM% 96.2

Plot area harvested 0.00512 ha.

K TEST

Grain Yield, tonnes/hectare

Tables of means

K_Test	K0	K1	K2	Mean
OLD_RES				
O	3.59	4.37	4.44	4.00
D	4.69	5.45	4.76	4.90
N*	3.63	3.99	4.24	3.87
PK	4.58	4.12	4.46	4.44
N*PK	4.27	4.41	4.44	4.35
Mean	4.15	4.47	4.47	4.31

Grain mean DM% 84.2

Straw Yield, tonnes/hectare

Tables of means

K_Test	K0	K1	K2	Mean
OLD_RES				
O	1.14	0.97	1.26	1.13
D	1.21	1.61	1.46	1.38
N*	0.78	0.93	1.04	0.88
PK	1.12	0.99	1.12	1.09
N*PK	1.04	1.24	1.34	1.16
Mean	1.06	1.15	1.24	1.13

Straw mean DM% 96.5

Plot area harvested 0.00512 ha

20/R/PG/5 PARK GRASS

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

The 165th year, hay.

For previous years see 'Details' 1977 and 1973 and Yield Books for 74-19/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 CaCO₃ 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 (0-23 cm) 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 2018; the ninth 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
15/08/2019	a Path cutting; ISTH4335 with Kilworth Topper	-	-
17/10/2019	a Path cutting. Topped all paths; ISTH4335 with Kilworth Topper	-	-
28/10/2019	a Mow. Cut all plots and surrounds before baling; JD6230 with Kuhn Mower Conditioner	-	-
12/03/2020	f Applied TSP; Plot 20; By Hand	73	kg/ha
12/03/2020	f Applied TSP; Plots 6; Sections a and b only; By Hand	83	kg/ha
12/03/2020	f Applied TSP; Plots 4/2, 4/1, 8, 7/2, 9/1, 9/2, 10, 11/1, 11/2, 14/2, 14/1, 15, 16; Sections a, b, c; JD5070 with Nordsten box	83	kg/ha
14/04/2020	f Applied ammonium sulphate (21% N); Plot 1; Sections a, b, c; JD5070 with Exactomatic	229	kg/ha
14/04/2020	f Applied ammonium sulphate (21% N); Plot 6; Sections a, b only; JD5070 with Exactomatic	229	kg/ha
14/04/2020	f Applied ammonium sulphate (21% N); Plots 4/2, 9/2, 10, 18; Sections a, b, c; JD5070 with Exactomatic	457	kg/ha
14/04/2020	f Applied ammonium sulphate (21% N); Plots 11/1, 11/2; Sections a, b, c; JD5070 with Exactomatic	686	kg/ha
15/04/2020	f Applied SOP; Plots 2/1, 6, 7/1, 7/2, 9/1, 9/2, 11/1, 11/2, 14/1, 14/2, 15, 16, 18, 20; Sections a, b, c	542	kg/ha
15/04/2020	f Applied SOP; Plot 20	108	kg/ha
15/04/2020	f Applied Silicate of Soda; Plot 11/2; Sections a, b, c	450	kg/ha
15/04/2020	f Applied sodium nitrate (16% N); Plot 20; JD5070 with Exactomatic	188	kg/ha
15/04/2020	f Applied sodium nitrate (16% N); Plots 16, 17; Sections a, b, c; JD5070 with Exactomatic	300	kg/ha
15/04/2020	f Applied sodium nitrate (16% N); Plot 14/2; Sections a, b, c; JD5070 with Exactomatic	600	kg/ha
15/04/2020	f Applied sodium nitrate (16% N); Plot 15; Sections a, b, c; JD5070 with Exactomatic	900	kg/ha
16/04/2020	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; Sections a, b, c	43	kg/ha
16/04/2020	f Applied Sulphate of Magnesia; Plots 6, 7/1, 7/2, 8, 9/1, 9/2, 10, 11/1, 11/2, 14/1, 14/2, 15, 16, 18; Sections a, b, c	111	kg/ha
22/06/2020	a Park Grass 1st Cut 2020. Harvested plots 20/3 to 4/1a; MF3070 with Wilder Grass Box	-	-
23/06/2020	a Park Grass 1st Cut 2020. Harvested Plots 3d to 17a; MF3070 with Wilder Grass Box	-	-
23/06/2020	a Mowed; JD6830 with Kuhn Mower Conditioner	-	-
23/06/2020	a Turning Over Cut Grass; JD5070 with Tedder	-	-
24/06/2020	a Turning Over Cut Grass; JD5070 with Tedder	-	-
25/06/2020	a Row up; MF3070 with PZ Hay Rake	-	-
25/06/2020	a Turning Over Cut Grass; JD5070 with Tedder	-	-
14/10/2020	a Path cutting; ISTH4335 with Kilworth Topper	-	-
11/01/2021	a Mowed all plots and surrounds; JD6620 with Kuhn Mower Conditioner	-	-
11/01/2021	a Baling off mown material. Material from plot 18d, 18c, 18/2, 18b, 18a, 19/1, 19/2, 19/3, 20/1, 20/2 and 20/3 not baled due to break down with baler (hydraulic pipe burst). Rest of field	-	-

baled and removed, Will return to bale the rest when baler is fixed; JD6230 with Claas Baler

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

Yields

1ST CUT (22-23 JUN 2020) DRY MATTER, TONNES/HECTARE

Tables of means

Grand mean		2.63					
Manure	Lime	a	b	c	d	Mean	
N1	1	2.00	1.61	1.21	0.45	1.32	
K	2/1	1.29	1.82	1.40	0.98	1.37	
None(FYM)	2/2	2.00	1.82	1.57	1.28	1.67	
None	3	1.85	1.95	1.11	0.83	1.44	
P	4/1	2.56	2.71	2.32	1.60	2.30	
N2P	4/2	2.82	2.95	2.90	1.39	2.51	
N1PKNaMg	6	4.51	3.72			4.12	
(P)KNaMg	7/1	3.43	3.34	2.16	1.31	2.56	
PKNaMg	7/2	4.18	3.86	3.28	2.17	3.37	
PNaMg	8	1.95	2.07	2.16	1.99	2.04	
PKNaMg(N2)	9/1	3.51	3.38	2.99	0.47	2.59	
N2PKNaMg	9/2	4.58	4.44	3.63	1.51	3.54	
N2PNaMg	10	2.57	2.74	2.68	1.06	2.26	
N3PKNaMg	11/1	4.25	3.76	3.93	1.60	3.38	
N3PKNaMgSi	11/2	5.19	4.04	3.69	1.64	3.64	
None	12	1.77	0.84	1.14	0.84	1.15	
(FYM/F)	13/1	2.27	1.97	1.69	1.45	1.85	
FYM/PM	13/2	3.11	3.49	3.15	3.03	3.20	
PKNaMg(N2*)	14/1	1.79	2.31	2.10	1.97	2.04	
N2*PKNaMg	14/2	4.91	4.71	4.50	4.46	4.64	
N3*PKNaMg(N2*)	15	5.47	4.56	5.68	4.40	5.03	
N1*PKNaMg	16	3.82	3.69	3.63	3.60	3.68	
N1*	17	1.45	1.91	1.46	1.84	1.67	

Results of the Classics and other Long-term Experiments 2020

20/R/PG/5

N2KNaMg 18	1.45	1.54	0.84	0.07	0.98
N2KNaMg 18/2					1.91
FYM 19/1					2.57
FYM 19/2					3.52
FYM 19/3					3.52
FYM/N*PK 20/1					4.53
FYM/N*PK 20/2					4.49
FYM/N*PK 20/3					4.34
1st cut mean DM%	35.0				

NO SECOND CUT WAS TAKEN IN 2020 BECAUSE THE BOX MOWER WAS CONDEMNED ON SAFETY GROUNDS

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

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

The 167th year, red clover.

For previous years see 'Details' 1967 and 1973, and Yield books for 74-19/R/GC/8.

Design: 2 blocks of 2 plots.

Whole plot dimensions: 1.00 m × 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	Unit
13/11/2019	a Epson Salts	50	kg/ha
13/11/2019	a TSP	75	kg/ha
13/11/2019	a Potassium Sulphate	150	kg/ha
13/11/2019	a Chalk	1.25	t/ha
11/05/2020	a 1 st Cut	-	-
14/07/2020	a 2 nd Cut	-	-
01/09/2020	a 3 rd Cut	-	-

Yields

Dry Matter, Tonnes/Hectare

Cut	Date	Grand Mean	FUNG_RES		Mean DM%
			NONE	BENOMYL	
1st	11 MAY 2020	3.77	3.74	3.81	14.0
2nd	14 JUL 2020	3.24	3.61	2.86	15.8
3rd	01 SEP 2020	2.47	2.56	2.37	17.7
Total of 3 cuts		9.48	9.91	9.04	15.9

20/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.

The 83rd year, leys, winter beans, winter wheat, winter rye

For previous years see 'Details' 1967 & 1973 and Yield Books for 74-19/W/RN/3.

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

Whole plot dimensions: 8.53 m × 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:

Ln3	(Previous LEY) LN1, LN2, LN3, W, R
Lc3	(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 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 2020
(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 2020 (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 K₂O ha⁻¹) as muriate of potash, applied where necessary to first test crop winter wheat and long-term leys in the wheat block, applied 2019 (see date below).

Continuous rotations	No FYM	FYM Res
Before wheat	Half plots	Half plots
ABe/Be	280	260
AO/O	260	380
LLn/AO	310	240
LLn/Ln3	-	60
Ln3	130	110
LLc/ABe	200	90
None to other plots.		

Experimental Diary

Date		Application	Rate	Units
ALL				
10/10/2019	a	Power harrow; JD6620 with Kuhn Powerharrow 3m		
22/10/2019	s	Drilled winter oats, var: Miscani; JD6620 with Accord 4m Tyne Drill	350	seeds/m ²
08/11/2019	a	Topped. Stackyard; Topper 9		
02/12/2019	p	Sprayed Hallmark with Zeon Technology; MF6150 with Knight Sprayer	50	ml/ha
02/12/2019	p	Sprayed Sprinter; MF6150 with Knight Sprayer	2	l/ha
02/07/2020	a	Mowed Grass Trails; JD6620 with Mower-Uniform CM166	-	-
15/09/2020	a	Harvested all plots. No problems with harvest. No yields from bean plots as plots failed.; Haldrup C-85		
15/09/2020	a	Harvested odds and ends of plots. Harvested areas of plots left after taking yield cut.; Haldrup C-85		
Grass ley and clover/grass leys (first year leys)				
20/06/2019	p	Sprayed Cello; MF6150 with Knight Sprayer	1.25	l/ha
08/10/2019	p	Spreading SOP; JD6930 Cascade Spreader	140	kg/ha
31/03/2020	f	Applied Nitram (34.5 % N); Plots 57, 58, 61, 62; JD6620 with Cascade Spreader	25	kg/ha

Results of the Classics and other Long-term Experiments 2020 20/W/RN/3

31/03/2020	f	Applied Nitram (34.5 % N); Plots 55, 56, 59, 60; JD6620 with Cascade Spreader	50 kg/ha
30/03/2020	a	Chisel plough - 1st year grass plots; JD6620 with Chisel Plough	- -
17/04/2020	f	Applied TSP; Block 4 (Plots 55-62); JD6620 with Cascade Spreader	213 kg/ha
17/04/2020	f	Applied MOP; Blocks 4 (Plots 55-62); JD6620 with Cascade Spreader	167 kg/ha
17/04/2020	f	Applied Nitram (34.5 % N); Block 4 (57, 58, 61, 62); JD6620 with Cascade Spreader	217 kg/ha
20/04/2020	f	Applied SOP; Block 4 (Plots 55-62); Applied late due to late sowing of grass ; JD6620 with Cascade Spreader	140 kg/ha
30/06/2020	a	Grass Plots 1st Cut; JD6620 with Wilder Grass Box	- -
02/07/2020	a	Row up grass. Grass plots; JD6620 with Tedder	- -
03/07/2020	a	Baling Grass. Grass plots; JD6620 with Claas Baler	- -
05/08/2020	f	Applied Nitram (34.5 % N); Plots 57, 58, 61, 62; JD6930 with Cascade Spreader	217 kg/ha

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

08/10/2019	f	Spreading SOP; JD6930 Cascade Spreader	140 kg/ha
17/04/2020	f	Applied TSP; Block 3 (Plots 33, 34, 37, 38, 41, 42, 43, 44), Block 5 (Plots 65, 66, 69, 70, 77, 78, 79, 80); JD6620 with Cascade Spreader	213 kg/ha
17/04/2020	f	Applied MOP; Blocks 3 (Plots 33, 34, 37, 38, 41-44), Block 5 (Plots 65, 66, 69, 70, 77-80); JD6620 with Cascade Spreader	167 kg/ha
17/04/2020	f	Applied Nitram (34.5 % N); Block 3 (Plots 37, 38, 43, 44), Block 5 (65, 66, 69, 70); JD6620 with Cascade Spreader	217 kg/ha
20/04/2020	f	Applied SOP; Block 3 (Plots 33, 34, 37, 38, 41, 42, 43, 44), Block 5 (Plots 65, 66, 69, 70, 77, 78, 79, 80); JD6620 with Cascade Spreader	150 kg/ha

Results of the Classics and other Long-term Experiments 2020

20/W/RN/3

30/06/2020	a	Grass Plots 1st Cut; JD6620 with Wilder Grass Box	-	-
02/07/2020	a	Row up grass. Grass plots; JD6620 with Tedder	-	-
03/07/2020	a	Baling Grass. Grass plots; JD6620 with Claas Baler	-	-
05/08/2020	f	Applied Nitram (34.5 % N); Plots 37, 38, 43, 44, 65, 66, 69, 70; JD6930 with Cascade Spreader	217	kg/ha
W Wheat				
29/05/2019	p	Sprayed Sprinter; MF6150 with Knight Sprayer	3	l/ha
08/10/2019	f	Spreading TSP; JD6930 Cascade Spreader	127	kg/ha
08/10/2019	f	Spreading SOP; JD6930 Cascade Spreader	150	kg/ha
09/10/2019	a	Ploughing; Thrown E; WES Dowdeswell 100 Series Five Furrow Plough	-	-
10/10/2019	a	Power harrow; JD6620 with Kuhn Power harrow 3m	-	-
22/10/2019	s	Drilled winter wheat, var: Crusoe; JD6620 with Accord 4m Tyne Drill	350	seeds/m ²
02/12/2019	p	Sprayed Hallmark with Zeon Technology; MF6150 with Knight Sprayer	50	ml/ha
02/12/2019	p	Sprayed Liberator; MF6150 with Knight Sprayer	0.6	l/ha
02/12/2019	p	Sprayed Sprinter; MF6150 with Knight Sprayer	2	l/ha
25/03/2020	p	Sprayed Palio; MF6150 with Knight Sprayer	0.265	kg/ha
25/03/2020	p	Sprayed Sprinter; MF6150 with Knight Sprayer	3	l/ha
06/04/2020	f	Applied Nitro-chalk (27 % N); Block 1; By Hand	148	kg/ha
09/04/2020	f	Applied MOP as Corrective K; Plot 11	60	kg/ha
09/04/2020	f	Applied MOP as Corrective K; Plot 16	90	kg/ha
09/04/2020	f	Applied MOP as Corrective K; Plot 13	110	kg/ha
09/04/2020	f	Applied MOP as Corrective K; Plot 14	130	kg/ha

Results of the Classics and other Long-term Experiments 2020

20/W/RN/3

09/04/2020	f	Applied MOP as Corrective K; Plot 15	200	kg/ha
09/04/2020	f	Applied MOP as Corrective K; Plot 10	240	kg/ha
09/04/2020	f	Applied MOP as Corrective K; Plots 1, 6	260	kg/ha
09/04/2020	f	Applied MOP as Corrective K; Plot 2	280	kg/ha
09/04/2020	f	Applied MOP as Corrective K; Plot 9	310	kg/ha
09/04/2020	f	Applied MOP as Corrective K; Plot 5	380	kg/ha
16/04/2020	f	Applied Nitro-chalk (27 % N); Block 1 (Plots 014, 021, 034, 043, 054, 061, 074, 084, 094, 102, 113, 123, 134, 143, 152, 163); By Hand	148	kg/ha
16/04/2020	f	Applied Nitro-chalk (27 % N); Block 1 (Plots 011, 023, 031, 042, 051, 063, 072, 081, 091, 103, 111, 121, 132, 142, 153, 162) ; By Hand	444	kg/ha
16/04/2020	f	Applied Nitro-chalk (27 % N); Block 1 (Plots 013, 022, 033, 044, 053, 062, 073, 083, 093, 101, 114, 124, 133, 144, 151, 164); By Hand	741	kg/ha
17/04/2020	f	Applied TSP; Block 1	150	kg/ha
20/04/2020	f	Applied SOP; Blocks 1; JD6620 with Cascade Spreader	150	kg/ha
09/05/2020	p	Sprayed Sprinter; MF6150 with Knight Sprayer	1	l/ha
09/05/2020	p	Sprayed Stefes CCC 72; MF6150 with Knight Sprayer	1	l/ha
09/05/2020	p	Sprayed Vortex; MF6150 with Knight Sprayer	1.5	l/ha
01/06/2020	p	Sprayed Azoxystar; MF6150 with Knight Sprayer	0.5	l/ha
01/06/2020	p	Sprayed Cello; MF6150 with Knight Sprayer	1.075	l/ha
01/06/2020	p	Sprayed Sprinter; MF6150 with Knight Sprayer	3	l/ha

W Rye

07/10/2019	f	Spreading chalk; JD6620 (block 2, 2nd test crop only)	5	t/ha
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Results of the Classics and other Long-term Experiments 2020

20/W/RN/3

08/10/2019	f	Spreading SOP; JD6930 Cascade Spreader	127	kg/ha
08/10/2019	f	Spreading TSP; JD6930 Cascade Spreader		kg/ha
09/10/2019	a	Ploughing; Thrown E; WES Dowdeswell 100 Series Five Furrow Plough	-	-
10/10/2019	a	Power harrow; JD6620 with Kuhn Powerharrow 3m	-	-
22/10/2019	s	Drilled winter rye, var: Mephisto; JD6620 with Accord 4m Tyne Drill	350	Seeds/m ²
02/12/2019	p	Sprayed Liberator; MF6150 with Knight Sprayer	0.6	l/ha
02/12/2019	p	Sprayed Sprinter; MF6150 with Knight Sprayer	2	l/ha
25/03/2020	p	Sprayed Palio; MF6150 with Knight Sprayer	0.265	kg/ha
25/03/2020	p	Sprayed Sprinter; MF6150 with Knight Sprayer	3	l/ha
31/03/2020	a	Rolled; JD6620 with Flexicoil Cambridge Roll		
16/04/2020	f	Applied Nitro-chalk (27% N); Block 2 (Plots 171, 182, 194, 204, 214, 223, 234, 241, 251, 263, 272, 283, 294, 303, 314, 321); By Hand	185	kg/ha
16/04/2020	f	Applied Nitro-chalk (27 % N); Block 2 (Plots 172, 184, 191, 202, 211, 222, 232, 243, 254, 261, 273, 281, 291, 301, 313, 324); By Hand	370	kg/ha
16/04/2020	f	Applied Nitro-chalk (27 % N); Block 2 (Plots 173, 181, 192, 203, 213, 224, 233, 244, 253, 264, 271, 284, 293, 302, 312, 322); By Hand	556	kg/ha
17/04/2020	f	Applied Nitram (34.5 % N); Block 4 (Plots 49-52, 53-54, 63-64); JD6620 with Cascade Spreader	290	kg/ha
17/04/2020	f	Applied TSP; Block 2, Block4 (Plots 49-54, 63, 64); JD6620 with Cascade Spreader	150	kg/ha
17/04/2020	f	Applied MOP; Blocks 3, 4, 5 ; Plots 33, 34, 37, 38, 41-44, 55-60, 61, 62, 65, 66, 69, 70, 77-80; JD6620 with Cascade Spreader	167	kg/ha
20/04/2020	f	Applied SOP; Blocks 2; Block 4 (plots 49-54, 63, 64); JD6620 with Cascade Spreader	150	kg/ha

09/05/2020	p	Sprayed Vortex; MF6150 with Knight Sprayer	1.5	l/ha
W Oats				
29/05/2019	p	Sprayed Cello; MF6150 with Knight Sprayer	1.25	l/ha
20/06/2019	p	Sprayed Sprinter; MF6150 with Knight Sprayer	2	l/ha
08/10/2019	f	Spreading SOP; JD6930 Cascade Spreader	150	kg/ha
08/10/2019	f	Spreading TSP; JD6930 Cascade Spreader	127	kg/ha
09/10/2019	a	Ploughing; Thrown E; WES Dowdeswell 100 Series Five Furrow Plough		
10/10/2019	a	Power harrow; JD6620 with Kuhn Powerharrow 3m		
22/10/2019	s	Drilled winter oats, var: Miscani; JD6620 with Accord 4m Tyne Drill	350	seeds/m ²
02/12/2019	p	Sprayed Hallmark with Zeon Technology; MF6150 with Knight Sprayer	50	ml/ha
02/12/2019	p	Sprayed Sprinter; MF6150 with Knight Sprayer	2	l/ha
17/04/2020	f	Applied TSP; Block 3 (Plots 35, 36, 39, 40), Block 4 (67, 68, 75, 76); JD6620 with Cascade Spreader	150	kg/ha
17/04/2020	f	Applied Nitram (34.5 % N); Block 3 (Plots 35, 36, 39, 40), Block 5 (Plots 67, 68, 75, 76); JD6620 with Cascade Spreader	290	kg/ha
20/04/2020	f	Applied SOP; Block 3 (plots 35, 36, 39, 40), Block 5 (plots 67, 68, 75-76); JD6620 with Cascade Spreader	150	kg/ha
09/05/2020	p	Sprayed Presite SX; MF6150 with Knight Sprayer	60	g/ha
09/05/2020	p	Sprayed Sprinter; MF6150 with Knight Sprayer	1	l/ha
09/05/2020	p	Sprayed Vortex; MF6150 with Knight Sprayer	1	l/ha
01/06/2020	p	Sprayed Azoxystar; MF6150 with Knight Sprayer	0.8	l/ha

01/06/2020	p	Sprayed Sprinter; MF6150 with Knight Sprayer	3	l/ha
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Winter Beans

08/10/2019		Spreading SOP; JD6930 Cascade Spreader	150	kg/ha
08/10/2019		Spreading TSP; JD6930 Cascade Spreader	127	kg/ha
09/10/2019	a	Ploughing; Thrown E; WES Dowdeswell 100 Series Five Furrow Plough		
10/10/2019		Power harrow; JD6620 with Kuhn Powerharrow 3m		
22/10/2019	s	Drilled winter beans, var: Tundra; JD6620 with Accord 4m Tyne Drill	21	seeds/m ²
25/03/2020	p	Sprayed Troy 48; MF6150 with Knight Sprayer	3	l/ha
15/04/2020	p	Sprayed Hallmark with Zeon Technology; MF6150 with Knight Sprayer	75	ml/ha
15/04/2020	p	Sprayed Laser; MF6150 with Knight Sprayer	1	l/ha
15/04/2020	p	Sprayed Sprinter; MF6150 with Knight Sprayer	2	l/ha
17/04/2020	f	Applied TSP; Block 3 (Plots 45-48), Block 4 (71-74); JD6620 with Cascade Spreader	150	kg/ha
20/04/2020	f	Applied SOP; Block 3 (Plots 45-48), Block 4 (71-74); JD6620 with Cascade Spreader	150	kg/ha

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

Yield Error Note: It was found that the FYM notation (dr) for some plots on Block 5 was incorrect in the 2020 field plan, and for several previous years (2003-2006, 2009). Consequently, the yield and plans for 2020 were corrected, but earlier yield books contain an error in some of the mean yields for FYM and NONE treatments.

LEYS

1ST CUT (30 JUN 2020) DRY MATTER TONNES/HECTARE

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

FYM_RES	LEYS	NONE	FYM	MEAN
	Lc1	1.05	1.08	1.07
	Lc2	4.89	5.43	5.16
	Lc3	0.81	0.94	0.87
	Ln1	0.90	0.71	0.80
	Ln2	4.87	5.13	5.00
	Ln3	4.35	3.84	4.10
	(LLc/Lc)Lc1	0.52	0.67	0.59
	(LLc/Lc)Lc2	4.93	4.37	4.65
	(LLc/Lc)Lc3	1.90	1.84	1.87
	(LLn/Ln)Ln1	0.39	0.69	0.54
	(LLn/Ln)Ln2	4.64	5.12	4.88
	(LLn/Ln)Ln3	2.67	3.13	2.90
	MEAN	2.66	2.75	2.70

1ST CUT MEAN DM% 33.50

NO SECOND CUT WAS TAKEN IN 2020

Note 1: No 2nd Cut of the first, second or third year leys (Lc3, Ln3, Lc3, (LLc/Lc)Lc3, (LLn/Ln)Ln3) was taken because the box mower was condemned on safety grounds.

Note 2: 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 – No yields due to very poor establishment and growth

RYE (EXTRA)

GRAIN (85% DRY MATTER) TONNES/HECTARE

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

FYMRES	NONE	FYM	Mean
ROTATION			
(ABe)R	1.94	2.51	2.22
(AO)R	3.05	3.53	3.29

(LLn/AO)R	3.23	3.30	3.27
(LLc/ABe)R	2.72	0.97	1.84
Mean	2.73	2.58	2.66
Grain mean DM%	87.0		
Plot area harvested (ha)	0.00393		

WINTER WHEAT

Grain tonnes/hectare

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

FYMRES	none	FYM	Mean		
ROTATION					
(AO)W	3.68	2.50	3.09		
(ABe)W	2.94	1.75	2.34		
(LLn/AO)W	2.33	3.33	2.83		
(LLc/ABe)W	3.18	2.45	2.81		
(Ln)W	2.30	1.84	2.07		
(LLn/Ln)W	3.04	3.11	3.08		
(Lc)W	2.69	3.35	3.02		
(LLc/Lc)W	3.53	3.42	3.47		
Mean	2.96	2.72	2.84		
N	0	80	160	240	Mean
ROTATION					
(AO)W	2.76	3.26	2.91	3.44	3.09
(ABe)W	0.99	3.08	2.81	2.50	2.34
(LLn/AO)W	1.96	3.65	2.70	3.01	2.83
(LLc/ABe)W	1.10	3.44	3.73	2.99	2.81
(Ln)W	1.83	1.87	2.76	1.83	2.07
(LLn/Ln)W	2.40	3.87	4.09	1.95	3.08
(Lc)W	1.89	3.82	3.05	3.30	3.02
(LLc/Lc)W	1.87	3.72	4.26	4.05	3.47
Mean	1.85	3.34	3.29	2.88	2.84
N	0	80	160	240	Mean
FYMRES					
none	1.96	3.33	3.52	3.04	2.96
FYM	1.74	3.35	3.06	2.73	2.72

Mean	1.85	3.34	3.29	2.88	2.84
N		0	80	160	240
ROTATION	FYMRES				
(AO)W	none	2.96	3.71	3.47	4.59
	FYM	2.56	2.81	2.35	2.28
(ABe)W	none	1.30	3.23	4.28	2.93
	FYM	0.67	2.93	1.35	2.06
(LLn/AO)W	none	2.48	2.94	2.00	1.90
	FYM	1.45	4.36	3.40	4.13
(LLc/ABe)W	none	0.95	3.45	4.32	3.99
	FYM	1.24	3.44	3.15	1.98
(Ln)W	none	2.13	1.99	3.05	2.03
	FYM	1.52	1.74	2.47	1.62
(LLn/Ln)W	none	2.04	3.80	4.35	1.99
	FYM	2.76	3.95	3.83	1.92
(Lc)W	none	1.82	3.74	2.24	2.95
	FYM	1.97	3.90	3.87	3.64
(LLc/Lc)W	none	2.00	3.76	4.47	3.90
	FYM	1.74	3.67	4.04	4.21
Mean		1.85	3.34	3.29	2.88

Grain mean DM% 87.10
Plot area harvested (ha) 0.00183

Note: Wheat yield on plot 012 (ABe - FYM) were lower than expected, but the reason is not known.

WINTER RYE

Grain tonnes/hectare

Tables of means

FYMRES	none	FYM	Mean
ROTATION			
(AO)R	2.81	2.33	2.57
(ABe)R	1.79	2.52	2.15

(LLn/AO)R	3.85	3.94	3.90			
(LLc/ABe)R	2.84	2.69	2.77			
(Ln)R	3.74	3.13	3.43			
(LLn/Ln)R	2.85	2.91	2.88			
(Lc)R	3.04	3.72	3.38			
(LLc/Lc)R	3.43	2.86	3.14			
Mean	3.04	3.01	3.03			
	N	0	50	100	150	Mean
ROTATION						
(AO)R	1.21	2.67	2.92	3.47	2.57	
(ABe)R	1.17	2.22	2.85	2.36	2.15	
(LLn/AO)R	2.43	4.73	4.15	4.27	3.90	
(LLc/ABe)R	1.48	3.32	2.80	3.47	2.77	
(Ln)R	3.02	3.81	4.21	2.69	3.43	
(LLn/Ln)R	2.67	3.28	3.14	2.44	2.88	
(Lc)R	2.93	4.47	3.26	2.86	3.38	
(LLc/Lc)R	2.47	3.74	3.60	2.76	3.14	
Mean	2.17	3.53	3.37	3.04	3.03	
	N	0	50	100	150	Mean
FYMRES						
none	2.22	3.56	3.34	3.06	3.04	
FYM	2.13	3.51	3.39	3.02	3.01	
Mean	2.17	3.53	3.37	3.04	3.03	
	N	0	50	100	150	
ROTATION	FYMRES					
(AO)R	none	1.54	2.95	3.15	3.60	
	FYM	0.88	2.39	2.69	3.34	
(ABe)R	none	1.18	1.66	2.39	1.91	
	FYM	1.15	2.79	3.32	2.81	
(LLn/AO)R	none	2.74	4.67	3.95	4.03	
	FYM	2.12	4.80	4.35	4.50	

(LLc/ABe)R	none	1.53	3.19	2.81	3.85
	FYM	1.43	3.46	2.79	3.09
(Ln)R	none	2.58	4.39	5.04	2.97
	FYM	3.46	3.24	3.39	2.41
(LLn/Ln)R	none	2.98	3.48	2.83	2.12
	FYM	2.36	3.07	3.45	2.75
(Lc)R	none	2.52	3.93	2.91	2.80
	FYM	3.34	5.01	3.62	2.91
(LLc/Lc)R	none	2.67	4.19	3.65	3.20
	FYM	2.27	3.29	3.55	2.32
	Mean	2.17	3.53	3.37	3.04
Grain mean DM%		87.20			
Plot area harvested (ha)		0.00183			

Note: The Rye yields on plots 49 (LLc/ABe -FYM) and 201 (AO - FYM) were lower than expected, but the reason is not known.

WINTER OATS

GRAIN (85% DRY MATTER) TONNES/HECTARE

Tables of means

FYMR	NONE	FYM	Mean
ROTATION			
ABe	2.66	2.38	2.52
AO	1.87	1.93	1.90
LLc/ABe	3.23	3.12	3.18
LLn/AO	2.00	1.86	1.93
Mean	2.44	2.32	2.38

Grain mean DM%	85.2
Plot area harvested (ha)	0.00393

20/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.

The 56th year, Winter Beans.

For previous years see 'Details' 1973 and Yield Books for 74-19/W/RN/12.

Design: 4 blocks of 8 plots

Whole plot dimensions: 8.0 m × 29.5 m (8.0 m × 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 7.5 t/ha. CC: cover crop prior to spring sown crops. Co: compost at 40 t/ha. Dg10: FYM at 10 t/ha. Dg25: FYM at 25 t/ha. Dg: FYM at 50 t/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:

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

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)

For 2018 Winter rye rates were 0, 30, 60, 90, 120 & 150 kg N/ha as Nitro-chalk (27% N)

For 2019 Spring barley rates were 0, 35, 70, 105, 140 & 175 kg N/ha as Nitro-chalk (27% N)

Experimental Diary

Date		Application	Rate	Units
24/09/2019	a	Topped; JD6620 Topper 9	-	-
30/09/2019	f	Applied FYM; Plots 008, 014, 018, 028; By Hand	10	t/ha
01/10/2019	f	Applied FYM; Plots 005, 011, 023, 026; By Hand	25	t/ha
01/10/2019	f	Applied compost; Plots 007, 012, 021, 027; By Hand	40	t/ha
02/10/2019	f	Applied straw; Plots 003, 015, 017, 031; By Hand	7.5	t/ha
03/10/2019	a	Ploughing; Direction thrown: E; JD6620 with Dowdeswell 100 Series Five Furrow Plough	-	-
03/10/2019	a	Topped straw that has been spread on Plots 003, 015, 017, 031 to try and make it easier to plough in; JD6620 with Topper 9	-	-

Results of the Classics and other Long-term Experiments 2020

20/W/RN/12

10/10/2019	a	Power harrow; JD6620 with Kuhn Powerharrow 3m	-	-
17/10/2019	a	Rolled; JD6620 with Flexicoil Cambridge Roll	-	-
22/10/2019	s	Drilled winter beans, var: Tundra; JD6620 with Accord Tyne Drill	-	-
05/11/2019	a	Topped grass plot paths; ISTH4335 with Kilworth Topper	-	-
25/03/2020	p	Sprayed Troy 480; Winter Beans; MF6150 with Knight Sprayer	3	l/ha
15/04/2020	p	Sprayed Hallmark with Zeon Technology; Winter Beans; MF6150 with Knight Sprayer	75	ml/ha
15/04/2020	p	Sprayed Laser; Winter Beans; MF6150 with Knight Sprayer	1	l/ha
15/04/2020	p	Sprayed Sprinter; Winter Beans; MF6150 with Knight Sprayer	2	l/ha
17/04/2020	f	Applied potassium sulphate; Winter Beans; JD6620 with Cascade Spreader	200	kg/ha
17/04/2020	f	Applied triple superphosphate; Winter Beans; JD6620 with Cascade Spreader	97.5	kg/ha
01/06/2020	a	Crop failure. Winter bean crop failed and was not harvested	-	-
30/06/2020	a	Grass Plots 1st Cut 2020; JD6620 with Wilder Grass Box	-	-
02/07/2020	a	Mowed Grass Trails; JD6620 with Mower-Unifarm	-	-
02/07/2020	a	Row up grass. Grass plots; JD6620 with Tedder	-	-
03/07/2020	a	Baling Grass. Grass plots; JD6620 with Claas Baler	-	-

Yields**WINTER BEANS – Crop failed, No yields available.****GRASS/CLOVER**

DRY MATTER TONNES/HECTARE

***** Table of means *****

Year	1 st Cut	2 nd 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
2019	2.34	0.39	2.73
2020	1.01	-	-

Cut dry matter t/ha (30 JUNE 2020). No second cut was taken.

Note: Herbage samples were taken for chemical analyses and archiving.

Weather Summaries

Rothamsted Research - Harpenden

The weather: Monthly Summary: 2020

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

	Sunshine		Mean temperatures °C								Rain		Rain	Drainage	Wind
	Hours	()	Maximum		Minimum		Dew point	Ground	In ground under grass		Tipping Bucket (turf wall)		days**	20" mm	km/hr***
			°C	()	°C	()	°C	frosts*	30 cm	100 cm	Total mm	()			
January	59.4	(-2.65)	8.90	(+2.20)	3.81	(+2.61)	4.55	11	6.73	7.87	79.8	(+9.83)	24	71.3	9.2
February	92.3	(+12.07)	9.71	(+2.80)	3.23	(+2.31)	4.00	10	6.49	7.35	127.0	(+76.86)	23	115.2	14.6
March	166.4	(+51.55)	10.63	(+0.74)	2.73	(+0.06)	2.88	15	6.94	7.38	43.8	(-7.00)	17	10.7	11.4
April	243.1	(+81.93)	16.57	(+3.94)	4.73	(+0.71)	5.43	9	9.73	8.80	51.4	(-3.66)	8	3.4	7.8
May	308.6	(+113.97)	18.85	(+2.77)	6.99	(+0.12)	7.18	8	12.60	11.05	3.2	(-51.49)	2	1.8	7.5
June	199.6	(+1.45)	20.46	(+1.32)	10.94	(+1.18)	10.75	0	15.23	13.31	87.4	(+34.14)	18	2.0	7.4
July	192.2	(-12.96)	21.46	(-0.30)	11.90	(+0.01)	11.47	0	16.72	14.92	81.2	(+31.33)	15	6.5	7.2
August	169.2	(-27.01)	22.96	(+1.39)	14.15	(+2.31)	14.04	0	18.03	16.29	172.0	(+108.27)	15	34.3	7.6
September	185.2	(+41.81)	19.51	(+1.23)	9.79	(-0.13)	10.99	2	15.88	15.67	32.8	(-24.83)	10	1.3	7.4
October	70.9	(-40.85)	13.78	(-0.26)	7.95	(+0.82)	9.21	6	12.60	13.61	198.4	(+116.72)	27	92.1	8.2
November	63.9	(-6.88)	11.52	(+1.80)	5.38	(+1.58)	7.20	11	10.34	11.61	57.4	(-19.23)	24	20.0	7.6
December	50.0	(-3.84)	7.25	(+0.36)	2.60	(+0.94)	3.84	12	7.44	9.35	98.4	(+28.88)	22	94.8	7.9
Year	1800.9	(+208.58)	15.13	(+1.50)	7.02	(+1.04)	7.63	84	11.56	11.43	1032.8	(+299.82)	205	453.4	8.6

* 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 : 2020
 (Departure from 30-year means (1981 - 2010) in brackets)

	Sunshine		Mean temperatures °C								Rain		Wind	
	Hours	()	Maximum		Minimum		Dew	Ground	In ground under grass		Total mm	Rain	***	
			()	()	point	frosts *	30 cm	100 cm	Tipping bucket	days **	km/hr			
										()				
January	61.3	(+1.27)	9.2	(+2.14)	3.9	(+2.66)	4.6	11	6.5	8.3	67.0	(+12.47)	20	9.9
February	89.8	(+14.89)	10.1	(+2.76)	2.9	(+2.01)	4.1	15	6.5	7.8	83.2	(+41.04)	25	14.7
March	176.5	(+63.07)	11.1	(+0.70)	2.0	(-0.65)	3.3	20	7.0	7.9	33.4	(-12.51)	17	10.5
April	243.7	(+92.73)	16.9	(+3.86)	3.6	(-0.14)	5.8	16	10.3	9.1	45.8	(-6.41)	6	6.2
May	315.2	(+127.96)	19.3	(+2.80)	5.2	(-1.37)	8.0	11	13.9	11.4	7.2	(-46.06)	7	6.8
June	215.1	(+27.24)	21.0	(+1.46)	10.3	(+0.87)	11.3	0	17.2	14.0	78.0	(+27.93)	17	7.5
July	196.8	(-0.31)	21.7	(-0.43)	11.5	(-0.09)	12.2	0	17.7	15.6	65.4	(+15.51)	16	8.6
August	161.5	(-27.34)	23.3	(+1.41)	13.5	(+1.91)	14.2	0	19.0	16.9	102.2	(+44.40)	15	7.9
September	182.9	(+45.88)	19.9	(+1.18)	9.1	(-0.52)	10.8	2	15.6	16.1	39.3	(-17.77)	8	7.7
October	60.7	(-51.12)	13.8	(-0.64)	7.7	(+0.76)	8.8	4	12.1	14.0	149.9	(+79.05)	26	8.7
November	60.8	(-5.40)	11.5	(+1.52)	4.8	(+1.03)	6.4	8	9.5	12.0	44.6	(-17.83)	20	8.0
December	39.0	(-6.61)	7.2	(+0.05)	2.3	(+0.81)	3.2	16	6.7	9.6	93.0	(+37.25)	23	7.7
Year	1803.3	(+282.25)	15.4	(+1.39)	6.4	(+0.60)	7.7	103	11.8	11.9	809.1	(+157.06)	200.0	8.7

* 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