Results of the Classical and Other Long-term Experiments 2021

Full Table of Content

Default Title

Rothamsted Research

Rothamsted Research (2023) *Default Title ;* Results Of The Classical And Other Long-Term Experiments 2021 , pp -1 - 45 **- DOI: https://doi.org/10.23637/ERADOC-1-271**

ROTHAMSTED RESEARCH

Results of the

Classical and other

Long-Term Experiments

2021

https://doi.org/10.23637/ERADOC-1-271

Contents

Conventions i

21/R/BK/1 BROADBALK WINTER WHEAT 1

21/R/HB/2 HOOSFIELD SPRING BARLEY (Hoosfield) 12

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

21/R/EX/4 EXHAUSTION LAND (Hoosfield) 18

21/R/PG/5 PARK GRASS 22

21/R/GC/8 GARDEN CLOVER (Manor Garden) 28

21/W/RN/3 WOBURN LEY-ARABLE (Stackyard D, Woburn Farm) 29

21/W/RN/12 WOBURN ORGANIC MANURING (Stackyard B, Woburn Farm) 41

Weather Summaries 45

The information and data contained in this Yield Book is correct to the best of our knowledge. Any errors that arise will be corrected in the electronic version. Printed copies of this Yield Book should therefore be checked against the electronic version by checking the version date.

This version is dated **6 November 2023**.

The Rothamsted Long-Term Experiments – National Capability is funded by the UK Research and Innovation – Biotechnology and Biological Sciences Research Council (UKRI-BBSRC) (Grant BBS/E/C/000J0300; 2017-2023) and receives support from the Lawes Agricultural Trust.

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% SO_3
FYM	Farmyard manure (from bullocks)
Headland Manganese 500	500 g/l 27.5% w/w $MnCO_3$
Kieserite	$MgSO_4H_2O$; 17.7% Mg and 23.3% S
Maize Tops	
Magnesium sulphate	$MgSO_4$ H_2O; 17.7% Mg and 23.3% S
Manganese sulphate	Mn_2 $(SO_4)_3$; 27% Mn and 24% S
Manganese and Dinitrate ('Sprinter')	14% w/w and 7.2% w/w Nitric Nitrogen
Muriate of potash (MOP)	KCl; 60% K_2O (49.8% K)
Nitram	34.5% N
Nitraprill	34.5% N
Nitrate of soda	$NaNO_3$; 16% N and 27% Na
Nitro-Chalk	Calcium Ammonium Nitrate; 27% N
Silicate of soda	Na_2SiO_3; 37% Na and 23% Si
Sodium Sulphate	35% Na
Sulphate of ammonia	$(NH_4)_2SO_4$; 21% N and 24% S
Sulphate of potash (SOP)	K_2SO_4; 50% K_2O (41.5% K) and 18.4% S
Triple superphosphate (TSP)	47% P_2O_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://doi.org/10.23637/ERADOC-1-271 *pp 4*

(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 (MAPP or ADJ number)	Function	Active ingredient
Ally Max SX (18768)	h	143.000 g/kg metsulfuron-methyl and 143.000 g/kg tribenuron-methyl
Buffalo Elite	water conditioner	ammonium sulphate (40 % w/w), water conditioner
Caramba 90 (15524)	f	90.000 g/L metconazole
Cello (18290)	f	100.000 g/L prothioconazole, 250.000 g/L spiroxamine and 100.000 g/L tebuconazole
Cogent (A0902)	ad	32.67 % w/w alkoxylated alcohols and 1.0 % w/w trisiloxane organosilicone copolymers
Cortez (16280)	f	125 g/L (12.1% w/w) epoxiconazole
Cytokin P (?)	gr	No information available
Envoy (16297)	f	85 g/L (8.2% w/w) pyraclostrobin plus 62.5 g/L (6% w/w) epoxiconazole
Firestarter (18422)	h	100.000 g/L diflufenican and 400.000 g/L flufenacet
Hallmark with Zeon Technology (12629)	i	100.000 g/L lambda-cyhalothrin
Hurler (17715)	h	200.000 g/L fluroxypyr
Laser (17339)	h	200.000 g/L cycloxydim
Lentyma XE (19301)	f	66.700 g/L fluxapyroxad and 70.000 g/L Mefentrifluconazole
Mobius (13395)	f	175.000 g/L prothioconazole and 150.000 g/L trifloxystrobin
Moddus (15151)	gr	250.000 g/L trinexapac-ethyl
Ninja 5CS (16417)	i	50.000 g/L lambda-cyhalothrin
Plexeo 60 (18281)	f, gr	60 g/L metconazole
Pontos (17811)	h	240.000 g/L flufenacet and 100.000 g/L picolinafen
Presite SX (18776)	h	67.000 g/kg metsulfuron-methyl and 333.000 g/kg thifensulfuron-methyl
Retengo 200 (19551)	f	200.000 g/L pyraclostrobin
Samurai (16238)	h	360.000 g/L glyphosate
Simveris (19619)	f	90.000 g/L metconazole
Starane HI-Load HL (16557)	h	333.000 g/L fluroxypyr
Stefes CCC 720 (17731)	gr	720.000 g/L chlormequat
Velogy Plus (17866)	f	100.000 g/L benzovindiflupyr
Velomax (A0831)	ad	86.8 % w/w oil (rapeseed fatty acid esters), 5.2 % w/w alkoxylated alcohols, 2.5 % w/w oil (tall oil fatty acids)
X-Clude	water conditioner	
Zarado (A0516)	ad	70.0 % w/w oil (rapeseed fatty acid esters)

https://doi.org/10.23637/ERADOC-1-271 *pp 5*

Machinery Referred to in the Diary Notes

Cultivators	Manufacturer	Width	Description
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.

Drills	Manufacturer	Width	Description
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)

Chemical Applicators	Manufacturer	Width	Description
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)

Harvesters	Manufacturer	Width	Description
Amazone Groundkeeper Smart Cut - GHS Drive 1500	Amazone		Flail mower collector, specially modified by Trials Equipment UK to cut and weigh grass. This was commissioned for 2021 to replace the Wilder Grass Box Mower previously used for grass yields but which was no longer fit for purpose.
Tucano 430	Claas	6 m	Commercial combine used for harvesting discards after plot yields.
Box Mower	Wilder	1.01 m	No longer used. Box mower mainly used for yields on PG/5 up until 2020.
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 from 2017).

Other	Manufacturer	Width	Description
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).

https://doi.org/10.23637/ERADOC-1-271 *pp 6*

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.

Tractors	**Manufacturer**	**Weight**	**Description**
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.

https://doi.org/10.23637/ERADOC-1-271

21/R/BK/1 BROADBALK WINTER WHEAT

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. The experimental diary below also includes the Broadbalk 'Wilderness' (R/BK/1W) – a 0.2 ha area of land at the west end of the field taken out of cultivation in 1882 and which now supports 'wooded', 'mown' and 'stubbed' sections.

2021 was the 178th 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 74-20/R/BK/1.

Areas harvested [a]:

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

[a] The 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 are based on a 2.0 m cut width.

Treatments:

In 2021 some of the treatments were changed. The treatments are now:

Whole plots

PLOT

	Plot	From 2021
01 (FYM) N4	01	(FYM) N4
2.1 FYM N3	2.1	FYM N3
2.2 FYM	2.2	FYM
03 Nil	03	Nil
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)KMg	12	N1+3+1 (P) K Mg
13 N4PK	13	N4 (P) K
14 N4PK*(Mg*)	14	N4 (P) K* (Mg*)
15 N5(P)KMg	15	N5 (P) K Mg

https://doi.org/10.23637/ERADOC-1-271

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

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 N plots for wheat.

– Split N to wheat
N1+1+1, 1+2+1 etc: Rates as above, but in 3 splits. 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; oats received no N from 1996 to 2017.

Winter Beans (Be) No N applied.

All crops P, K, Mg & FYM applications as shown below:-
P: 35 kg P as triple superphosphate
(P): No P since 2001 or 2021 (under review)
K: 90 kg K as potassium sulphate
K*: 90 kg K as potassium chloride
Mg: 12 kg Mg as kieserite
(Mg*): No Mg since 2001 (under review)
FYM: Farmyard manure at 35 t (fresh weight) to wheat and oats in autumn; no FYM applied to beans (oats received no FYM from 1996 to 2017)

Previous treatment:

Whole plots

PLOT Fertilizers and organic manures:-

	Plot	Treatments until 1967	Treatments from 1968	Treatments from 1985 – 2000	Treatments from 2001-2020
01 DN4PK	01	-	D N2 P K	D N4 P K	N4
2.1 DN2	2.1	D	D N2	D N2	FYM N3 (1)
2.2 D	2.2	D	D	D	FYM
03 0	03	Nil	Nil	Nil	Nil
05 F	05	P K Na Mg	P K (Na) Mg	P K Mg	(P) K Mg
06 N1F	06	N1 P K Na Mg	N1 P K (Na) Mg	N1 P K Mg	N1 (P) K Mg
07 N2F	07	N2 P K Na Mg	N2 P K (Na) Mg	N2 P K Mg	N2 (P) K Mg
08 N3F	08	N3 P K Na Mg	N3 P K (Na) Mg	N3 P K Mg	N3 (P) K Mg
09 N4F	09	N*1 P K Na Mg	N4 P K (Na) Mg	N4 P K Mg	N4 (P) K Mg
10 N2	10	N2	N2	N2	N4
11 N2P	11	N2 P	N2 P	N2 P	N4 P Mg
12 N2PNA	12	N2 P Na	N2 P Na	N2 P Na	N1+3+1 (P) K Mg (2)
13 N2PK	13	N2 P K	N2 P K	N2 P K	N4 P K
14 N2PKMG	14	N2 P Mg*	N2 P K Mg*	N2 P K Mg*	N4 P K* (Mg*)
15 N5F	15	N2 P K Na Mg	N3 P K (Na) Mg	N5 P K Mg	N5 (P) K Mg
16 N6F	16	N*2 P K Na Mg	N2 P K (Na) Mg	N6 P K Mg	N6 (P) K Mg
17 N1+3FH	17	N2 (A)	N2 ½[P K (Na) Mg]	N1+3 ½[P K Mg] (A)+	N1+4+1 P K Mg
18 N0+3FH	18	P K Na Mg (A)	N2 ½[P K (Na) Mg]	N0+3 ½[P K Mg] (A)+	N1+2+1 P K Mg
19 (C)	19	C	C	(C) (since 1989)	N1+1+1 K Mg
20 N2KMG	20	N2 K Na Mg	N2 K (Na) Mg	N2 K Mg	N4 K Mg

(1) N2 2001-2004
(2) N1+3+1 (P) K2 Mg2 2001-2005
(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.

https://doi.org/10.23637/ERADOC-1-271 *pp 9*

Winter oats; Nitrogen and dung were not applied, 1996-2017.

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
K2:	180 kg K as potassium sulphate (plus 450 kg K autumn 2000 only)
Na:	55 kg Na as sulphate of soda
(Na):	16 kg Na as sulphate of soda until 1973
Mg:	12 kg Mg from 2001, previously 35 kg Mg every third year 1974-2000 (applied at 30 kg Mg in 1991, 1994, 1997 and 2000 and at 15 kg Mg on half rate treatments), and 11 kg Mg until 1973. Mg* indicates plot 14 applications of 26 kg Mg 1990 to 2000, previously 30 kg Mg 1974-1989, and 31 kg Mg until 1973. All Mg applied as kieserite since 1974, previously as sulphate of magnesia until 1973.
Mg2:	24 kg Mg as kieserite (plus 60 kg Mg, autumn 2000 only)
D:	Farmyard manure at 35 t (fresh weight)
(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

https://doi.org/10.23637/ERADOC-1-271 *pp 10*

Section	1	9	0*	8+	6**	5	3	7	4	2
Year										
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
2021	W	W	W	W	W	Be	W	O	W	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 2.9 t 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 and 2018, see 14/R/BK/1 and 19/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 (22 February 2013) because of the very wet autumn and winter of 2012-2013.

(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.

https://doi.org/10.23637/ERADOC-1-271 *pp 11*

(6) Section 8 was left in bare fallow in 2015 & 2016 and had two in-season cultivations (inversion ploughing) each year to control weeds.

(7) No Triple Superphosphate applied to Strips 11, 13 and 14: After reviewing amounts of available P in soil it was decided not to apply TSP from 2021 (under review).

21/R/BK/1 Experimental Diary:

Date		Application	Rate	Unit
All Sections				
16/09/2020	p	Sprayed Samurai (16238) using NH T6030, Knight 24m Sprayer	3	L/ha
16/09/2020	p	Sprayed Buffalo Elite using NH T6030, Knight 24m Sprayer	1	L/ha
16/09/2020	a	Rolled; 6m Flexicoil Cambridge Roll, JD6230	-	-
21/09/2020	f	Applied Triple Superphosphate (TSP) using Cascade Spreader: Strips 17, 18	171	kg/ha
22/09/2020	f	Applied Farmyard manure (FYM) using Tym T503, Muck spreader – international: All sections except 5, Strips 2.1, 2.2;.	35	t/ha
22/09/2020	f	Applied Muriate of Potash (MOP): Strip 14; Cascade Spreader	181	kg/ha
22/09/2020	a	Topping plot boundaries using Batwing Topper, JD6230: paths between plots before ploughing due to weed growth.	-	-
23/09/2020	a	Cultivation: Ploughed Tillage 15 cm; NHT7210, KV Five Furrow Plough: Thrown S		
01/10/2020	p	Sprayed using Tym T503, Tecnoma 12m Sprayer: Pontos (17811);	1	L/ha
01/10/2020	p	Sprayed using Tym T503, Tecnoma 12m Sprayer: Firestarter (18422)	0.3	L/ha
01/10/2020	p	Sprayed using Tym T503, Tecnoma 12m Sprayer: Velomax	0.4	L/ha
02/12/2020	p	Sprayed using Knight 24m Sprayer, NH T6030: Hallmark with Zeon Technology: Sections 0, 1, 2, 3, 4, 6, 7, 8, 9	50	mL/ha
30/03/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: X-Clude;	0.25	L/ha
30/03/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Cintac;	0.5	L/ha
30/03/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Cogent	1	L/ha
04/04/2021	a	Ploughed Tillage 0 cm down paths only; Rotavator Howard, Tym T503		
12/05/2021	f	Applied Kieserite with Cascade Spreader, JD6830: Section 0, 1, 2, 3, 4, 5, 6, 7, 8, 9: Strip 05, 06, 07, 08, 09, 11, 12, 15, 16, 17, 18, 19, 20	80	kg/ha
14/05/2021	f	Applied Sulphate of Potash (SOP) with Cascade Spreader, JD6830: Section 0, 1, 2, 3, 4, 5, 6, 7, 8, 9: Strip 05, 06, 07, 08, 09, 12, 13, 15, 16, 17, 18, 19, 20	217	kg/ha
03/06/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Samurai (16238): Section 0, 1, 2, 3, 4, 5, 6, 7, 9	3	L/ha
03/06/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Buffalo Elite: Section 0, 1, 2, 3, 4, 5, 6, 7, 9	1	L/ha
26/06/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Caramba 90	0.359	L/ha
26/06/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Simveris	0.4	L/ha

https://doi.org/10.23637/ERADOC-1-271 *pp 12*

26/06/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Cytokin P	1	L/ha
26/06/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Laser	0.75	L/ha
26/06/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Zarado	1	L/ha
08/07/2021	a	Wild Oat Count by hand: Section 0, 1, 2, 3, 4, 5, 6, 7, 8, 9: Strip 01, 2.1, 2.2, 03, 05, 06, 07, 08, 09, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20	-	-
13/07/2021	a	Power harrowed Paths	-	-

W Wheat

28/09/2020	s	Drilled Zyatt with JD6830, Accord Combination Drill No. 4 : Section 0, 1, 2, 3, 4, 6, 8, 9	350	seeds/m^2
02/03/2021	f	Applied Nitram with Cascade Spreader, JD6830: Section 0, 1, 2, 3, 4, 6, 8, 9: Strip 12, 17, 18, 19	139	kg/ha
20/04/2021	f	Applied Nitram with Cascade Spreader, JD6830: Section 0, 1, 2, 3, 4, 6, 8, 9: Strip 06, 19	139	kg/ha
20/04/2021	f	Applied Nitram with Cascade Spreader, JD6830: Section 0, 1, 2, 3, 4, 6, 8, 9: Strip 07, 18	278	kg/ha
20/04/2021	f	Applied Nitram with Exactomatic, Cascade Spreader, JD6830: Section 0, 1, 2, 3, 4, 6, 8, 9: Strip 08, 12, 2.1	417	kg/ha
20/04/2021	f	Applied Nitram with Cascade Spreader, JD6830: Section 0, 1, 2, 3, 4, 6, 8, 9: Strip 01, 09, 10, 11, 13, 14, 17, 20	556	kg/ha
20/04/2021	f	Applied Nitram with Cascade Spreader, JD6830: Section 0, 1, 2, 3, 4, 6, 8, 9: Strip 15	696	kg/ha
20/04/2021	F	Applied Nitram with Cascade Spreader, JD6830: Section 0, 1, 2, 3, 4, 6, 8, 9: Strip 16	835	kg/ha
21/04/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Cortez: Sections 0, 1, 2, 3, 4, 8, 9	0.5	L/ha
21/04/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Moddus: Sections 0, 1, 2, 3, 4, 8, 9	0.1	L/ha
21/04/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Moddus: Section 6: Strip 01, 03, 05, 06, 07, 08, 09, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 2.1, 2.2	0.1	L/ha
12/05/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Lentyma XE: Section 0, 1, 2, 3, 4, 8, 9	1	L/ha
12/05/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Retengo 200: Section 0, 1, 2, 3, 4, 8, 9	0.4	L/ha
26/05/2021	f	Applied Nitram: Section 0, 1, 2, 3, 4, 6, 8, 9: Strip 12, 17, 18, 19	139	kg/ha
27/05/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Plexeo 60: Section 8	1.25	L/ha
27/05/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Velogy Plus: Section 8	0.63	L/ha
27/05/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Presite SX: Section 6	60	g/ha
27/05/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Hurler: Section 6	0.6	L/ha
27/05/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Presite SX: Section 0, 1, 2, 3, 4, 9	60	g/ha
27/05/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Plexeo 60: Section 0, 1, 2, 3, 4, 9	1.25	L/ha
27/05/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Velogy Plus: Section 0, 1, 2, 3, 4, 9	0.63	L/ha
27/05/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Hurler: Section 0, 1, 2, 3, 4, 9	0.6	L/ha
10/06/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Cello: Section 0, 1, 2, 3, 4, 8, 9	1	L/ha
27/08/2021	a	Harvest; Haldrup C-85 2m cut: Section 0, 1, 2, 3, 4, 6, 8, 9	-	-

https://doi.org/10.23637/ERADOC-1-271 *pp 13*

02/09/2021	a	Straw weights – Wheat using Amazone Grass Harvester - Flail Mower Collector, JD5070: Section 1, 3, 4, 8	-	-

W Oats

28/09/2020	s	Drilled Miscani : Section 7	350	seeds/m^2
20/04/2021	f	Applied Nitram with Cascade Spreader, JD6830: Section 7: Strip 06	70	kg/ha
20/04/2021	f	Applied Nitram with Cascade Spreader, JD6830: Section 7: Strip 07	139	kg/ha
20/04/2021	f	Applied Nitram: Section 7: Strip 2.1 by hand	209	kg/ha
20/04/2021	f	Applied Nitram with Cascade Spreader, JD6830: Section 7: Strip 08, 19	209	kg/ha
20/04/2021		Applied Nitram with Cascade Spreader, JD6830: Section 7: Strip 09, 10, 11, 13, 14, 18	278	kg/ha
20/04/2021	f	Applied Nitram with Cascade Spreader, JD6830: Section 7: Strip 12, 15	348	kg/ha
20/04/2021	f	Applied Nitram with Exactomatic, Cascade Spreader, JD6830: Section 7: Strip 16, 17	417	kg/ha
12/05/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Presite SX: Section 7	60	g/ha
12/05/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Envoy: Section 7	1.5	L/ha
12/05/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Stefes CCC 720: Section 7	1.5	L/ha
12/05/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Starane HI-Load HL: Section 7	0.4	L/ha
08/06/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Cello: Section 7	1	L/ha
11/08/2021	a	Harvest Winter Oats; Haldrup C-85 2m cut: Section 7	-	-
14/08/2021	a	Straw weights - Oats: Section 7	-	-
20/08/2021	a	Harvest; Haldrup C-85 2m cut: Section 7: Strip 01, 2.1, 2.2, 03, 05, 06, 07, 08, 09, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20	-	-

W Beans

08/03/2021	a	Tines using Bomford Flexitine, JD6145R : Section 5	-	-
08/03/2021	a	Rolling using 6m Flexicoil Cambridge Roll, JD6230: Section 5	-	-
08/03/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Samurai: Section 5	3	L/ha
08/03/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Buffalo Elite: Section 5	1	L/ha
09/03/2021	s	Drilled Tundra: Section 5	35	seeds/m^2
20/03/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Nirvana: Section 5	4	L/ha
20/03/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Velomax: Section 5	0.4	L/ha
29/04/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Ninja 5CS: Section 5	0.15	L/ha
28/05/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Hallmark with Zeon Technology: Section 5	75	mL/ha
27/08/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Samurai: Section 5	3	L/ha
27/08/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Buffalo Elite: Section 5	1	L/ha
06/09/2021	a	Harvest; Haldrup C-85 2m cut: Section 5	-	-

https://doi.org/10.23637/ERADOC-1-271 *pp 14*

08/09/2021	a	Straw weights using Amazone Grass Harvester - Flail Mower Collector, JD5070: Section 5	-	-
			-	-
Wilderness				
			-	-
05/01/2021	a	Topping Stubbed Area; Tym T503, McConnel SE 6 Topper	-	-
19/04/2021	a	Topping Mown Area; Iseki ISTH4335, Kilworth Topper	-	-
14/05/2021	a	Topping Mown Area; Iseki ISTH4335, Kilworth Topper	-	-
07/06/2021	a	Topping Mown Area; Iseki ISTH4335, Kilworth Topper	-	-
26/07/2021	a	Topping Mown Area; Iseki ISTH4335, Kilworth Topper	-	-
31/08/2021	a	Topping Mown Area; Iseki ISTH4335, Kilworth Topper	-	-
17/12/2021	a	Topping Stubbed Area; Iseki ISTH4335, Kilworth Topper	-	-

NOTE: Samples of grain and straw were taken for chemical analysis. Unground grain and straw samples from selected treatments were placed in the Rothamsted Sample Archive.

YIELDS

WINTER WHEAT

Grain Tonnes/Hectare (85% DM)

Tables of means

SECTION PLOT	3/W1	4/W1	2/W2	6/W44	0/W17	1/W55	9/W63	8/W5	Mean
01 (FYM)N4	8.29	8.47	7.62	3.97	-	-	-	-	7.09
21 FYMN3	10.06	9.94	9.53	4.40	5.30	8.33	8.54	1.15	7.15
22 FYM	6.70	7.46	6.48	5.22	5.51	6.30	6.11	3.09	5.86
03 Nil	0.07	0.14	0.21	0.05	0.21	0.30	0.19	0.55	0.21
05 (P)KMg	0.06	0.79	0.21	0.05	0.21	0.15	0.24	1.13	0.35
06 N1(P)KMg	4.16	5.27	4.90	2.26	3.36	3.84	3.47	0.65	3.49
07 N2(P)KMg	6.24	6.76	6.45	2.47	3.88	5.14	4.85	0.45	4.53
08 N3(P)KMg	7.63	8.16	7.82	2.10	5.67	4.66	5.79	0.38	5.28
09 N4(P)KMg	7.81	8.04	8.93	2.41	5.36	5.70	6.28	0.79	5.67
10 N4	2.36	3.96	4.08	1.11	0.45	1.45	0.73	0.63	1.85
11 N4(P*)Mg	4.65	6.52	6.33	1.96	6.66	5.56	4.79	0.66	4.64
12 N1+3+1(P)KMg	8.17	9.63	9.54	2.83	7.18	7.94	8.08	0.74	6.76
13 N4(P*)K	7.36	8.24	8.35	2.62	6.05	6.71	6.39	0.37	5.76
14 N4(P*)K*(Mg*)	5.07	6.43	5.90	2.60	5.40	5.31	4.54	0.80	4.51
15 N5(P)KMg	6.21	5.39	8.36	1.46	6.07	6.00	6.15	-	5.66
16 N6(P)KMg	7.29	7.49	8.61	1.73	6.43	4.93	7.09	0.67	5.53
17 N1+4+1PKMg	9.27	7.73	9.36	3.18	7.15	6.99	7.30	0.73	6.46
18 N1+2+1PKMg	8.62	8.73	9.13	3.44	7.15	6.66	7.61	0.89	6.53
19 N1+1+1KMg	6.60	6.04	6.98	2.03	5.32	3.88	6.17	0.51	4.69
20 N4KMg	-	-	-	-	0.91	0.15	-	-	0.53
Mean	6.14	6.59	6.78	2.42	4.64	4.74	5.24	0.83	4.72

Grain Mean DM% 84.3

https://doi.org/10.23637/ERADOC-1-271 *pp 15*

Straw Tonnes/Hectare

Tables of means

SECTION PLOT	3/W1	4/W1	2/W2	6/W44	0/W17	1/W55	9/W63	8/W5	Mean
01 (FYM)N4	2.40	3.12	-	-	-	-	-	-	2.76
21 FYMN3	4.62	4.29	-	-	-	3.67	-	1.56	3.53
22 FYM	2.72	3.04	-	-	-	3.01	-	3.96	3.18
03 Nil	0.61	0.07	-	-	-	0.05	-	0.60	0.33
05 (P)KMg	0.06	0.34	-	-	-	0.03	-	0.01	0.11
06 N1(P)KMg	0.90	1.28	-	-	-	1.14	-	1.09	1.10
07 N2(P)KMg	1.70	2.01	-	-	-	1.12	-	1.48	1.58
08 N3(P)KMg	1.71	1.54	-	-	-	0.41	-	0.61	1.07
09 N4(P)KMg	1.90	1.8	-	-	-	1.14	-	1.76	1.65
10 N4	1.26	1.07	-	-	-	0.55	-	0.08	0.74
11 N4(P*)Mg	0.43	0.92	-	-	-	1.50	-	0.91	0.94
12 N1+3+1(P)KMg	3.06	3.69	-	-	-	2.61	-	2.68	3.01
13 N4(P*)K	0.44	1.81	-	-	-	1.84	-	0.58	1.16
14 N4(P*)K*(Mg*)	1.04	0.66	-	-	-	1.25	-	1.59	1.13
15 N5(P)KMg	1.94	0.27	-	-	-	0.71	-	0.22	0.79
16 N6(P)KMg	1.35	0.96	-	-	-	1.39	-	1.55	1.31
17 N1+4+1PKMg	3.02	2.73	-	-	-	1.97	-	1.33	2.26
18 N1+2+1PKMg	3.94	3.24	-	-	-	2.46	-	2.33	2.99
19 N1+1+1KMg	0.64	0.76	-	-	-	1.35	-	1.35	1.02
20 N4KMg	-	-	-	-	-	0.11	-	-	0.11
Mean	1.78	1.77	-	-	-	1.38	-	1.32	1.56

Straw Mean DM% 86.00

WINTER OATS

Tonnes/Hectare (85% DM)

Table of means

Plot	Treatment	Grain	Straw
017	01 (FYM)1/2N4	8.24	3.17
217	02.1 FYM1/2N3	7.76	3.88
227	02.2 FYM	5.06	2.59
037	03 Nil	0.58	0.08
057	05 (P)KMg	1.46	0.30
067	06 1/2N1(P)KMg	3.20	0.70
077	07 1/2N2(P)KMg	4.13	1.50
087	08 1/2N3(P)KMg	5.08	1.57
097	09 1/2N4(P)KMg	7.34	2.78
107	10 1/2N4	5.01	1.91
117	11 1/2N4(P*)Mg	8.08	2.66
127	12 1/2N5(P)KMg	7.69	2.34
137	13 1/2N4(P*)K	7.22	2.76
147	14 1/2N4(P*)K*(Mg*)	4.83	2.35
157	15 1/2N5(P)KMg	5.96	3.18
167	16 1/2N6(P)KMg	6.94	2.97
177	17 1/2N6PKMg	7.70	3.45
187	18 1/2N4PKMg	6.07	2.41
197	19 1/2N3KMg	4.07	1.49

https://doi.org/10.23637/ERADOC-1-271 *pp 16*

Mean	5.60	2.22
Mean DM%	83.80	81.50
Plot Area Harvested (ha)	0.00463	

WINTER BEANS

TONNES/HECTARE (85% DM)

Tables of means

Plot	Treatment	Grain	Straw
015	01 (FYM)[N4]	4.69	1.63
215	21 [FYMN3]	4.77	1.64
225	22 [FYM]	4.66	2.19
035	03 Nil	0.32	1.58
055	05 (P)KMg	3.04	1.86
065	06 [N1](P)KMg	2.59	1.51
075	07 [N2](P)KMg	3.15	1.08
085	08 [N3](P)KMg	2.10	1.41
095	09 [N4](P)KMg	1.89	1.43
105	10 [N4]	0.37	0.33
115	11 [N4](P*)Mg	0.13	0.92
125	12 [N1+3+1](P)KMg	2.40	1.89
135	13 [N4](P*)K	2.54	2.35
145	14 [N4](P*)K*(Mg*)	1.71	2.03
155	15 [N5](P)KMg	2.07	2.16
165	16 [N6](P)KMg	2.10	2.10
175	17 [N1+4+1]PKMg	1.97	2.66
185	18 [N1+2+1]PKMg	3.11	2.50
195	19 [N1+1+1]KMg	2.21	2.85
	MEAN	2.41	1.79
Mean DM%		83.80	89.10
Plot Area Harvested (ha)		0.00463	

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

YEAR	**2021**
SECTION	**8/W5**
PLOT	
01 (FYM) N4	
2.1 FYMN3	1.08
2.2 FYM	2.82
03 Nil	0.52
05 (P)KMg	0.96
06 N1(P)KMg	0.56
07 N2(P)KMg	0.40
08 N3(P)KMg	0.34
09 N4(P)KMg	0.69
10 N4	0.53
11 N4(P)Mg	0.58
12 N1+3+1(P)K2Mg2	0.67
13 N4(P)K	0.31
14 N4(P)K*(Mg*)	0.64
15 N5(P)KMg	
16 N6(P)KMg	0.56
17 N1+4+1PKMg	0.63

https://doi.org/10.23637/ERADOC-1-271 *pp 17*

18 N1+2+1PKMg	0.77
19 N1+1+1KMg	0.43
20 N4KMg	
Mean	0.74

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.

https://doi.org/10.23637/ERADOC-1-271 *pp 18*

21/R/HB/2 HOOSFIELD SPRING 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 170th year, spring barley.

For previous years see 'Details' 1967 and 1973, Station Report for 1966 and Yield Books for 74-20/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 48 kg N
P: 35 kg P as triple superphosphate in 1974 and from 1988 to 2002, single superphosphate in other years
(P): (none) under review
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 at 35 kg Mg to new plot 63.
(Mg): (none) under review
D1852: Farmyard manure at 35 t (fresh weight) since 1852
D2001: Farmyard manure at 35 t (fresh weight) since 2001
(D): Farmyard manure at 35 t (fresh weight) 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

https://doi.org/10.23637/ERADOC-1-271 *pp 19*

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*

https://doi.org/10.23637/ERADOC-1-271 *pp 20*

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
13/10/2020	f	Applied Triple Superphosphate (TSP): Plots 631-634 (Series AA); By Hand	215	kg/ha
13/10/2020	f	Applied Kieserite: Plots 631-634 (Series AA) ; By Hand	233	kg/ha
26/10/2020	f	Applied Sulphate of Potash (SOP); JD830 with Cascade Spreader: Plots 141-144, 241-244, 311-314, 321-324, 331-334, 341-344, 411-414,421-424, 431-434, 441-444, 551, 552, 561, 562, 571, 572, 581, 582, 631-634	217	kg/ha
28/10/2020	f	Applied Silicate of Soda: By hand - plots 433, 333, 233, 133, 432, 332, 232, 132	450	kg/ha
04/11/2020	f	Applied Farmyard Manure (FYM); Tym T503 with Muck Spreader - Plots 721-724, 731-734	35	t/ha
25/02/2021	a	Ploughed Tillage 20 cm: Thrown N	-	-
08/03/2021	a	Spring Tines; JD6145R with Cousins Spring Tines	--	
08/03/2021	s	Drilled Diablo; JD6830 with Accord Combination Drill No.4	350	Seeds/m^2
09/03/2021	a	Rolling; JD6230 with 6m Flexicoil Cambridge Roll	-	-
27/04/2021	a	Power harrowed Paths; Iseki ISTH4335 with Kilworth Power Harrow 1.3m	-	-
17/05/2021	f	Applied Nitro Chalk (27% N); By Hand: Plots 113, 124, 211, 222, 313, 321, 412, 421, 611, 621, 631, 712, 721, 732	178	kg/ha
17/05/2021	f	Applied Nitro Chalk (27% N)); By Hand: Plots 112, 123, 212, 223, 314, 324, 414, 422, 613, 624, 634, 711, 722, 731	356	kg/ha
17/05/2021	f	Applied Nitro Chalk (27% N)); By Hand: Plots 114, 122, 213, 224, 312, 323, 411, 424, 612, 622, 632, 714, 723, 733	533	kg/ha
27/05/2021	f	Applied Nitram; JD6830 with Cascade Spreader: Series AA. C strip 5 and O&E only	417	kg/ha

https://doi.org/10.23637/ERADOC-1-271 *pp 21*

24/06/2021	p	Sprayed Mobius; NH T6030 with Knight 24m Sprayer	0.4	L/ha
09/07/2021	a	Wild Oat Count	-	-
04/09/2021	a	Harvest plots - grain yields; Haldrup C-85 2m Cut.	-	-
04/09/2021	a	Straw weights; JD5070 with Amazone Grass Harvester – Flail Mower Collector	-	-
13/09/2021	a	Operation: Baling ; JD6145R with McHale Fusion 2 Baler	-	-

Yields

Main Plots

Grain Yield, tonnes/hectare

Table of means

N	0	48	96	144	Mean
MANURE					
---	0.67	0.48	0.42	0.51	0.52
-P-	1.31	3.05	2.56	2.31	2.31
--K	0.85	0.75	1.30	1.00	0.97
-PK	1.54	3.09	3.73	4.40	3.19
A--	0.35	0.70	0.65	0.48	0.54
AP-	1.58	2.36	2.37	2.67	2.25
A-K	0.56	0.79	1.10	0.91	0.84
APK	1.66	3.29	3.89	4.74	3.39
FYM1852onwards	5.08	6.21	7.15	7.26	6.43
FYM1852-1871	1.51	1.42	1.50	4.99	2.35
(A)	1.33	2.08	2.93	2.35	2.17
-	1.00	0.81	1.30	1.07	1.05
FYM2001onwards	4.68	5.71	6.24	7.03	5.91
P2K	2.05	3.99	4.97	6.00	4.25
Mean	1.73	2.48	2.86	3.27	2.58
Grain mean DM%	81.10				

Straw Yield, tonnes/hectare

Table of means

N	0	48	96	144	Mean
MANURE					
---	0.45	0.32	1.42	0.37	0.64
-P-	0.24	1.29	1.50	1.68	1.18
--K	0.18	0.41	0.59	0.68	0.46
-PK	0.60	1.18	1.83	2.05	1.42
A--	0.46	0.34	0.45	0.57	0.46
AP-	0.58	1.07	0.39	1.69	0.93
A-K	0.25	1.11	0.80	0.93	0.78
APK	0.77	0.60	1.71	2.35	1.36
FYM1852onwards	2.53	2.13	2.78	2.15	2.40
FYM1852-1871	0.97	0.93	0.33	2.06	1.07
(A)	1.10	0.39	0.60	1.08	0.79
-	0.56	0.95	1.53	0.47	0.88
FYM2001onwards	1.54	3.47	1.19	2.52	2.18
P2K	2.76	2.63	2.28	4.06	2.93
Mean	0.93	1.20	1.24	1.62	1.25
Straw mean DM%	83.70				
Plot Area (ha)	0.00244	0.00183			

https://doi.org/10.23637/ERADOC-1-271 *pp 22*

PHOSPHATE PLOTS

Grain Yield, tonnes/hectare

Tables of means

PLOT	
142	1.76
143	1.66
144	1.38
242	3.73
243	3.58
244	3.37
341	2.10
342	2.79
343	2.89
344	3.26
441	3.02
442	3.22
443	3.28
444	3.11
551	3.25
552	3.14
561	3.55
562	3.11
571	2.37
572	2.95
581	0.61
582	0.65
Mean	2.67

Grain Mean DM%	83.80
Plot area Harvested (ha)	0.00244

SILICATE PLOTS

Grain Yield, tonnes/hectare

Tables of means

PK	N3--	N3P-	N3-K	N3PK	Mean
Silicate					
(-)-	0.81	2.40	0.76	3.07	1.76
(Si)-	0.73	2.68	1.52	3.14	2.02
(-)Si	1.43	2.66	1.42	3.55	2.26
(Si)Si	1.32	2.33	1.78	3.54	2.24
Mean	1.07	2.52	1.37	3.33	2.07

Grain Mean DM%	83.80	
Plot area harvested (ha)	0.00244	Means exclude missing values

https://doi.org/10.23637/ERADOC-1-271 *pp 23*

21/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 166th year. For previous years see 'Details' 1967, 1973 and Yield Books for 74-20/R/WF/3.

Experimental Diary

Date		Application	Rate	Units
21/09/2020	p	Sprayed using Knight 24m Sprayer, NH T6030: Samurai	3	L/ha
21/09/2020	p	Sprayed using Knight 24m Sprayer, NH T6030: Buffalo Elite	1	L/ha
19/10/2020	a	Ploughed Tillage 20 cm: Thrown N	-	-
19/10/2020	s	Drilled KWS Zyatt	350	seeds/m2
01/12/2020	p	Sprayed using Knight 24m Sprayer, NH T6030: Hallmark with Zeon Technology (12629)	50	mL/ha
02/12/2020	p	Sprayed using Knight 24m Sprayer, NH T6030: Pontos	0.5	L/ha
02/12/2020	p	Sprayed using Knight 24m Sprayer, NH T6030: Firestarter	0.6	L/ha
02/12/2020	p	Sprayed using Knight 24m Sprayer, NH T6030: Velomax	0.4	L/ha
20/04/2021	f	Applied Nitram	145	kg/ha
12/05/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Lentyma XE	1	L/ha
12/05/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Retengo 200	0.4	L/ha
23/06/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Cello	0.66	L/ha
11/08/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Samurai	3	L/ha
11/08/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Buffalo Elite	1	L/ha
19/08/2021	a	Harvest	-	-
20/08/2021	a	Baled	-	-

https://doi.org/10.23637/ERADOC-1-271 *pp 24*

21/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 166th year, winter wheat.

For previous years see 'Details' 1977, 1973 and Yield Books for 74-20/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 (fresh weight)
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 (fresh weight)
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

https://doi.org/10.23637/ERADOC-1-271 *pp 25*

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

O	None (2 sub-plots within each treatment strip)
K1	75 kg K_2O (62.2 kg K)
K2	150 kg K_2O (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
21/09/2020	f	Applied Triple Superphosphate (TSP) using Cascade Spreader, JD6830: Plots 011, 012, 021-024, 031, 032, 041-044, 051, 052, 061-064, 071, 072, 081-084, 091, 092, 101-104	75	kg/ha
21/09/2020	p	Sprayed using Knight 24m Sprayer, NH T6030: Samurai (16238)	3	L/ha
21/09/2020	p	Sprayed using Knight 24m Sprayer, NH T6030: Buffalo Elite	1	L/ha
22/09/2020	f	Applied Muriate of Potash (MOP) using Cascade Spreader, JD6830: Plots 103, 083, 063, 043, 023	125	kg/ha
22/09/2020	f	Applied Muriate of Potash (MOP) using Cascade Spreader, JD6830: Plots 011-014, 024, 031-034, 044, 051-054, 064, 071-074, 084, 091-094, 104	250	kg/ha
07/10/2020	a	Path cutting using Kilworth Topper, Iseki ISTH4335	-	-
19/10/2020	a	Ploughed Tillage 20 cm using NHT7210, KV Five Furrow Plough: Thrown N	-	-
19/10/2020	s	Drilled using JD6830, Accord Combination Drill No. 4: KWS Zyatt	350	seeds/m^2
01/12/2020	p	Sprayed using Knight 24m Sprayer, NH T6030: Hallmark with Zeon Technology	50	mL/ha
02/12/2020	p	Sprayed using Knight 24m Sprayer, NH T6030: Pontos	0.5	L/ha
02/12/2020	p	Sprayed using Knight 24m Sprayer, NH T6030: Firestarter	0.6	L/ha
02/12/2020	p	Sprayed using Knight 24m Sprayer, NH T6030: Velomax	0.4	L/ha
04/04/2021	a	Cultivated Paths only		
21/04/2021	f	Applied Sulphate of Ammonia using Cascade Spreader, JD6830: All Plots	238	kg/ha
12/05/2021	f	Applied Kieserite using Cascade Spreader, JD6830: All Plots	80	kg/ha
12/05/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Lentyma XE	1	L/ha
26/05/2021	f	Applied Nitram using Cascade Spreader, JD6830 : All Plots	580	kg/ha
09/06/2021	f	Applied Nitram using Cascade Spreader, JD6830: All Plots	145	kg/ha
23/06/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Cello	0.66	L/ha

https://doi.org/10.23637/ERADOC-1-271 *pp 26*

15/07/2021	a	Power harrowed Paths using Iseki ISTH4335, Kilworth Power Harrow 1.3 m	-	-
02/08/2021	a	Path Cutting using Iseki ISTH4335, Kilworth Topper	-	-
11/08/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Samurai	3	L/ha
11/08/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Buffalo Elite	1	L/ha
26/08/2021	A	Harvest Surrounds using Claas Tucano 430	-	-
26/08/2021	a	Harvest Plots using Haldrup C-85 2m cut	-	-
27/08/2021	a	Straw weights using JD5070, Amazone Grass Harvester - Flail Mower Collector	-	-

Yields

P TEST

Tables of means

Grain Yield, tonnes/hectare

P_RES OLD_RES	O	(P1)	(P2)	(P3)	Mean
O	2.35	4.40	6.27	6.36	4.85
D	3.00	6.11	7.48	7.05	5.91
N	2.05	4.30	6.40	6.93	4.92
P	2.67	5.97	7.18	6.96	5.69
NPKNAMG	2.04	5.68	7.00	7.12	5.46
Mean	2.42	5.29	6.86	6.88	5.36
Grain mean DM%	85.00				

Straw Yield, tonnes/hectare

P_RES OLD_RES	O	(P1)	(P2)	(P3)	Mean
O	0.49	1.42	1.09	1.35	1.09
D	0.84	2.11	2.13	2.03	1.78
N	0.49	1.17	2.20	3.03	1.72
P	0.87	2.34	2.79	2.31	2.08
NPKNAMG	1.44	1.68	1.84	2.20	1.79
Mean	0.83	1.74	2.01	2.18	1.69
Straw mean DM%	85.20				

Plot area harvested 0.00512 ha.

K TEST

Tables of means

Grain Yield, tonnes/hectare

K_Test OLD_RES	K0	K1	K2	Mean
O	6.02	6.78	6.97	6.45
D	7.36	8.25	7.26	7.56
N*	6.82	7.40	6.85	6.97
PK	6.64	5.88	5.95	6.28
N*PK	7.06	7.70	7.72	7.38
Mean	6.78	7.20	6.95	6.93
Grain mean DM%	85.20			

https://doi.org/10.23637/ERADOC-1-271 *pp 27*

Straw Yield, tonnes/hectare

K_Test	K0	K1	K2	Mean
OLD_RES				
O	2.78	2.87	2.69	2.78
D	2.31	2.50	2.64	2.44
N*	2.21	2.91	1.66	2.25
PK	2.20	3.13	2.62	2.54
N*PK	2.02	3.29	2.50	2.46
Mean	2.30	2.94	2.42	2.49
Straw mean DM%	84.10			

Plot area harvested 0.00512 ha

https://doi.org/10.23637/ERADOC-1-271 *pp 28*

21/R/PG/5 PARK GRASS

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

The 166th year, hay.
For previous years see 'Details' 1977 and 1973 and Yield Books for 74-20/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 (N*2)	Plot 14/1	P K Na Mg (+ N*2 until 1989)
N*2PKNaMg	Plot 14/2	N*2 P K Na Mg
N*3PKNaMg (N*2)	Plot 15	N*3 P K Na Mg (N*2 until 1875; P K Na Mg 1876-2012)
N*1PKNaMg	Plot 16	N*1 P K Na Mg
N*1	Plot 17	N*1
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
N*1, N*2, N*3:	48, 96, 144 kg N as nitrate of soda (30 kg N to plot 20 in years with no FYM). In 2013 plot 15 started to receive 144 kg N as nitrate of soda to provide a comparison with plot 11/1, which receives 144 kg N as sulphate of ammonia.
P:	17 kg P applied as triple superphosphate since 2017, except for plot 20 which receives 15 kg P in years with no FYM. Prior to this, 35 kg P (15 kg P to plot 20 in years with no FYM) 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 FYM) 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 (fresh weight) every fourth year

https://doi.org/10.23637/ERADOC-1-271 *pp 29*

F:	Fishmeal every fourth year to supply 63 kg N (stopped 1999; replaced by PM)
PM	Pelleted poultry manure at 2 t (fresh weight), 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 $CaCO_3$ 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 (0-23 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
22/03/2021	f	Applied Chalk by hand: Plots 2/1c, 2/2a, 2/2b, 3b, 4/1b, 7/1c, 7/2c, 12/c, 13/1c, 13/2b, 15c	0.3	t/ha
22/03/2021	f	Applied Chalk by hand: Plots 3a, 8b, 9/1b, 9/1c, 14/1b, 15b	0.5	t/ha
22/03/2021	f	Applied Chalk by hand: Plots 1b, 1c, 2/1b, 4/2c, 7/1b, 7/2b, 10c, 12/b, 13/1b, 18/c	0.75	t/ha
22/03/2021	f	Applied Chalk by hand: Plot 4/2b	1	t/ha
22/03/2021	f	Applied Chalk by hand: Plot 10b	1.25	t/ha
22/03/2021	f	Applied Chalk by hand: Plots 2/1a, 9/1a, 9/2b, 11/1b, 11/1c, 11/2c, 18/b	1.5	t/ha
22/03/2021	f	Applied Chalk by hand: Plots 12/a, 13/1a, 17a	1.75	t/ha
22/03/2021	f	Applied Chalk by hand: Plots 1a, 4/1a, 9/2c, 11/2b, 13/2a, 14/1a, 14/2a	2	t/ha
22/03/2021	f	Applied Chalk by hand: Plots 6b, 7/1a, 7/2a, 8a, 9/2a, 10a, 15a, 16a	2.5	t/ha
22/03/2021	f	Applied Chalk by hand: Plots 11/2a	3	t/ha
22/03/2021	f	Applied Chalk by hand: Plot 6a	3.5	t/ha
22/03/2021	f	Applied Chalk by hand: Plots 4/2a, 11/1a, 18/a	4	t/ha

https://doi.org/10.23637/ERADOC-1-271 *pp 30*

06/04/2021	f	Applied TSP using Nordsten 3m fertiliser box, JD5070 : Plots 4/1, 4/2, 6, 7/2, 8, 9/1, 9/2, 10, 11/1, 11/2, 14/1, 14/2, 15, 16; Sub-plots a, b, c, d	83	kg/ha
09/04/2021	f	Applied SOP using Quick Pass, JD5070; Plots 2/1, 6, 7/1, 7/2, 9/1, 9/2, 11/1, 11/2, 14/1,14/2, 15, 16, 18; Sub-plots a, b, c, d	542	kg/ha
09/04/2021	f	Applied Silicate of Soda using Quick Pass, JD5070; Plot 11/2; Sub-plots a, b, c, d	450	kg/ha
09/04/2021	f	Applied Sulphate of Soda using Quick Pass, JD5070; Plots 6, 7/1, 7/2, 8, 9/1, 9/2, 10, 11/1, 11/2, 14/1,14/2, 15, 16, 18; Sub-plots a, b, c, d	43	kg/ha
09/04/2021	f	Applied Sulphate of Magnesia using Quick Pass, JD5070; Plots 6, 7/1, 7/2, 8, 9/1, 9/2, 10, 11/1, 11/2, 14/1,14/2, 15, 16, 18; Sub-plots a, b, c, d	111	kg/ha
13/04/2021	f	Applied Sulphate of Ammonia using Ransomes Nordsten Lift o-matic Fertiliser Box, JD5070: Plots 1 (Sub-plots a-d), 6a, 6b	229	kg/ha
13/04/2021	f	Applied Sulphate of Ammonia using Ransomes Nordsten Lift o-matic Fertiliser Box, JD5070: Plots 4/2, 9/2, 10, 18; Sub-plots a, b, c, d	457	kg/ha
13/04/2021	f	Applied Sulphate of Ammonia using Ransomes Nordsten Lift o-matic Fertiliser Box, JD5070: Plots 11/1, 11/2; Sub-plots a, b, c, d	686	kg/ha
12/04/2021	f	Applied Sodium Nitrate using Ransomes Nordsten Lift o-matic Fertiliser Box, JD5070: Plot 20	188	kg/ha
13/04/2021	f	Applied Sodium Nitrate using Ransomes Nordsten Lift o-matic Fertiliser Box, JD5070: Plot 16, 17; Sub-plots a, b, c, d	300	kg/ha
13/04/2021	f	Applied Sodium Nitrate using Ransomes Nordsten Lift o-matic Fertiliser Box, JD5070: Plot 14/2; Sub-plots a, b, c, d	600	kg/ha
13/04/2021	f	Applied Sodium Nitrate using Ransomes Nordsten Lift o-matic Fertiliser Box, JD5070: Plot 15; Sub-plots a, b, c, d	900	kg/ha
14/04/2021	f	Applied FYM using Muck spreader - international, Tym T503: Plots 13/2, 19, 20	35	t/ha
30/04/2021	a	Cut Paths using Kilworth Topper, Iseki ISTH4335	-	-
14/06/2021	a	Cut Paths using Kilworth Topper, Iseki ISTH4335	-	-
14-15/06/2021	a	Harvesting using Amazone Grass Harvester - Flail Mower Collector, JD5070 : Cut 1	-	-
14/07/2021	a	Mowing using JD6830, Kuhn Mower Conditioner	-	-
14/07/2021	a	Turning	-	-
08-09/11/2021	a	Harvesting using Amazone Grass Harvester - Flail Mower Collector, JD5070: Cut 2	-	-
16/11/2021	a	Rowing up using PZ Hay Rake, JD5070	-	-

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

https://doi.org/10.23637/ERADOC-1-271 *pp 31*

Yields

1ST CUT (14-15 JUN 2021) DRY MATTER, TONNES/HECTARE

Tables of means

Grand mean **3.61**

Manure	Lime	a	b	c	d	Mean
N1	1	2.67	2.57	2.15	1.56	2.24
K	2/1	2.88	2.50	2.13	1.74	2.31
None(FYM)	2/2	2.72	2.69	2.05	1.50	2.24
None	3	2.96	2.93	2.00	1.53	2.35
P	4/1	2.95	3.30	2.32	2.09	2.66
N2P	4/2	3.26	2.98	2.71	1.25	2.55
N1PKNaMg	6	5.28	4.65	-	-	4.96
(P)KNaMg	7/1	5.06	3.60	2.22	1.73	3.15
PKNaMg	7/2	6.15	4.72	2.51	1.94	3.83
PNaMg	8	2.56	3.52	2.39	2.00	2.62
PKNaMg(N2)	9/1	5.42	4.49	3.65	1.39	3.74
N2PKNaMg	9/2	6.40	6.14	5.27	2.40	5.05
N2PNaMg	10	4.26	4.15	3.58	1.53	3.38
N3PKNaMg	11/1	6.88	4.80	6.02	3.09	5.20
N3PKNaMgSi	11/2	6.35	4.98	5.66	3.81	5.20
None	12	2.66	2.12	2.07	2.69	2.38
(FYM/F)	13/1	2.60	3.19	3.06	2.71	2.89
FYM/PM	13/2	3.91	4.38	4.71	4.19	4.30
PKNaMg(N*2)	14/1	4.16	4.77	2.98	2.97	3.72
N*2PKNaMg	14/2	5.43	6.62	5.09	5.39	5.63
N*3PKNaMg(N*2)	15	7.94	6.53	5.41	4.92	6.20
N*1PKNaMg	16	5.21	5.38	4.51	4.26	4.84
N*1	17	2.76	2.53	2.00	2.09	2.34
N2KNaMg	18	2.87	2.46	1.93	1.74	2.25
N2KNaMg	18/2	-	-	-	-	2.68
FYM	19/1	-	-	-	-	4.51
FYM	19/2	-	-	-	-	4.48
FYM	19/3	-	-	-	-	4.12
FYM/N*PK	20/1	-	-	-	-	5.16
FYM/N*PK	20/2	-	-	-	-	4.90
FYM/N*PK	20/3	-	-	-	-	4.67

1st cut mean DM% 27.30

https://doi.org/10.23637/ERADOC-1-271 *pp 32*

2nd CUT (08-09 NOV 2021) DRY MATTER, TONNES/HECTARE

Tables of means

Grand mean **2.42**

Manure	Lime	a	b	c	d	Mean
N1	1	2.10	1.82	2.04	1.13	1.77
K	2/1	2.59	2.09	2.35	2.08	2.28
None(FYM)	2/2	2.58	2.79	2.69	1.49	2.39
None	3	2.18	2.35	2.32	1.97	2.21
P	4/1	2.78	2.57	2.25	2.09	2.42
N2P	4/2	1.98	1.83	2.13	1.62	1.89
N1PKNaMg	6	2.09	1.75	-	-	1.92
(P)KNaMg	7/1	2.64	2.47	2.25	1.95	2.33
PKNaMg	7/2	2.43	2.73	2.72	2.04	2.48
PNaMg	8	2.37	2.71	2.95	2.04	2.52
PKNaMg(N2)	9/1	2.69	3.11	2.70	1.13	2.41
N2PKNaMg	9/2	2.42	2.62	2.51	2.26	2.45
N2PNaMg	10	2.00	1.95	2.91	2.11	2.24
N3PKNaMg	11/1	2.98	2.82	2.46	3.65	2.98
N3PKNaMgSi	11/2	3.57	3.04	2.26	3.12	3.00
None	12	2.32	1.97	2.73	2.43	2.36
(FYM/F)	13/1	2.65	3.17	2.82	2.61	2.81
FYM/PM	13/2	2.08	3.19	3.11	2.99	2.85
PKNaMg(N2*)	14/1	2.50	2.80	2.25	2.34	2.47
N*2PKNaMg	14/2	2.55	3.11	2.60	2.36	2.65
N*3PKNaMg(N*2)	15	2.19	3.04	3.07	2.31	2.65
N*1PKNaMg	16	2.19	2.97	2.68	1.78	2.40
N*1	17	2.35	1.86	2.52	1.71	2.11
N2KNaMg	18	2.45	2.26	1.81	1.16	1.92
N2KNaMg	18/2	-	-	-	-	2.25
FYM	19/1	-	-	-	-	2.79
FYM	19/2	-	-	-	-	3.27
FYM	19/3	-	-	-	-	2.85
FYM/N*PK	20/1	-	-	-	-	2.00
FYM/N*PK	20/2	-	-	-	-	3.03
FYM/N*PK	20/3	-	-	-	-	2.40

1st cut mean DM% 28.08

https://doi.org/10.23637/ERADOC-1-271 *pp 33*

TOTAL OF 2 CUTS DRY MATTER, TONNES/HECTARE

Tables of means

Grand mean **6.02**

Manure	Lime	a	b	c	d	Mean
N1	1	4.77	4.39	4.19	2.69	4.01
K	2/1	5.47	4.59	4.48	3.81	4.59
None(FYM)	2/2	5.30	5.48	4.74	2.99	4.62
None	3	5.14	5.28	4.32	3.50	4.56
P	4/1	5.72	5.87	4.57	4.18	5.09
N2P	4/2	5.23	4.81	4.84	2.87	4.44
N1PKNaMg	6	7.37	6.40	-	-	6.89
(P)KNaMg	7/1	7.70	6.07	4.47	3.68	5.48
PKNaMg	7/2	8.59	7.45	5.23	3.98	6.31
PNaMg	8	4.93	6.23	5.33	4.04	5.13
PKNaMg(N2)	9/1	8.11	7.60	6.34	2.52	6.14
N2PKNaMg	9/2	8.82	8.75	7.78	4.66	7.50
N2PNaMg	10	6.26	6.10	6.49	3.64	5.62
N3PKNaMg	11/1	9.86	7.63	8.48	6.74	8.18
N3PKNaMgSi	11/2	9.93	8.02	7.91	6.93	8.20
None	12	4.99	4.09	4.79	5.12	4.75
(FYM/F)	13/1	5.26	6.36	5.88	5.32	5.70
FYM/PM	13/2	5.99	7.57	7.83	7.18	7.14
PKNaMg(N*2)	14/1	6.66	7.56	5.23	5.32	6.19
N*2PKNaMg	14/2	7.98	9.72	7.69	7.75	8.28
N*3PKNaMg(N*2)	15	10.14	9.57	8.48	7.23	8.85
N*1PKNaMg	16	7.39	8.35	7.19	6.04	7.24
N*1	17	5.10	4.39	4.53	3.80	4.45
N2KNaMg	18	5.32	4.72	3.74	2.90	4.17
N2KNaMg	18/2	-	-	-	-	4.93
FYM	19/1	-	-	-	-	7.30
FYM	19/2	-	-	-	-	7.75
FYM	19/3	-	-	-	-	6.97
FYM/N*PK	20/1	-	-	-	-	7.16
FYM/N*PK	20/2	-	-	-	-	7.93
FYM/N*PK	20/3	-	-	-	-	7.07

1st cut mean DM% 27.69

https://doi.org/10.23637/ERADOC-1-271 *pp 34*

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

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

The 168th year, red clover.

For previous years see `Details' 1967 and 1973, and Yield books for 74-20/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
13/11/2020	f	Applied Triple Superphosphate (TSP): By Hand	75	kg/ha
13/11/2020	f	Applied Epsom Salts: By Hand	50	kg/ha
13/11/2020	f	Applied Sulphate of Magnesia: By Hand	150	kg/ha
13/11/2020	f	Applied Chalk: By Hand	1.25	kg/ha
01/06/2021	a	Harvest by hand: 1st Cut	-	-
14/07/2021	a	Harvest by hand: 2nd Cut	-	-
23/09/2021	a	Harvest by hand: 3rd Cut	-	-

Yields

Dry Matter, Tonnes/Hectare

			FUNG_RES		
Cut	Date	Grand Mean	NONE	BENOMYL	Mean DM%
1st	01 June 2021	3.68	3.54	3.82	12.7
2nd	14 July 2021	2.62	2.80	2.44	17.6
3rd	23 September 2021	1.21	1.21	1.20	19.9
Total of 3 cuts		7.50	7.55	7.46	16.7

https://doi.org/10.23637/ERADOC-1-271 *pp 35*

21/W/RN/3 WOBURN LEY-ARABLE (Stackyard D, Woburn Farm)

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

The 84th year, leys, winter beans, winter wheat, winter rye

For previous years see 'Details' 1967 & 1973 and Yield Books for 74-20/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 N, first year to eighth year, similarly for LLc – clover/grass ley, no N

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.

https://doi.org/10.23637/ERADOC-1-271 *pp 36*

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.

For 2021, a further change was made to replace winter beans (which had occasionally failed on the experiment) with winter barley (WB), and to synchronise all arable rotations. As a result, treatments ABe, AO, LLc/ABe and LLn/AO all follow the same rotation: R, WB, O, W, R.

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

Whole plots:

1. **ROTATION** Rotations before wheat:
   Ln 3
   Lc 3
   LLc/Lc3
   LLn/Ln3
   LLn/AO
   LLc/ABe
   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** N fertilizer as split dressings in spring (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

https://doi.org/10.23637/ERADOC-1-271 *pp 37*

Treatments to second test crop winter rye, all combinations of:

Whole plots:

1. **ROTATION** Rotations before first test crop:
   Ln 3
   Lc 3
   LLc/Lc3
   LLn/Ln3
   LLn/AO
   LLc/ABe
   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** N fertilizer in spring (kg N) as 34.5%:
   0
   50
   100
   150

Treatments to leys:

FYM RES Farmyard manure residues:
NONE
FYM 38 t (fresh weight) on each occasion, last applied 1960s.

NOTE: Corrective K dressings (kg K_2O) as muriate of potash, applied where necessary to first test crop winter wheat, applied 2020 (see date below). Note that for 2021, applications were based on rounded means calculated from 2016-2020 data in the absence of current data due to the COVID-19 pandemic.

Continuous rotations Before wheat	No FYM Half plots	FYM Res Half plots
Lc3	Plot 34: 0	Plot 33: 0
LLn/AO	Plot 36: 160	Plot 35: 160
LLn/Ln3	Plot 37: 10	Plot 38: 10
AO	Plot 40: 250	Plot 39: 250
LLc/Lc3	Plot 41: 0	Plot 42: 0
Ln3	Plot 43: 30	Plot 44: 30
ABe	Plot 45: 220	Plot 46: 220
LLc/ABe	Plot 47: 120	Plot 48: 120

https://doi.org/10.23637/ERADOC-1-271 *pp 38*

Experimental Diary

Date		Application	Rate	Units
ALL				
25/10/2020	P	Sprayed using WES 12m Knight Sprayer, WES MF6150: Samurai (16238):	2.5	L/ha
26/10/2020	a	Topping; Topper 9, JD6620		
04/11/2020	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Samurai (16238): Block 3 - Grass only	2.5	L/ha
05/11/2020	a	Topping; Topper 9, JD6620		
11/11/2020	a	Ploughed Tillage 20 cm in Stackyard Woburn; WES Dowdeswell 100 Series Five Furrow Plough, JD6620		
13/11/2020	a	Power Harrow; WES Power Harrow, JD6620.		
24/02/2021	a	Topping; Topper 9, JD6620	-	-
24/02/2021	a	Topping; Topper 9, JD6620	-	-
02/09/2021	a	Topping; Topper 9, JD6620	-	-
08/09/2021	a	Topping paths; Kilworth Topper, Iseki ISTH4335	-	-
05/10/2021	a	Applied Muriate of Potash (MOP) by hand: Block 2 - Plots 23, 24, 25, 26, 29, 30, 31, 32	0	
25/11/2021	a	Topping; Topper 9, JD6620		
Grass ley and clover/grass leys (1st year leys)				
26/10/2020	a	Topping using Topper 9, JD6620		
09/11/2020	f	Applied Triple Superphosphate (TSP): Block 2 - Plots 23, 24, 25, 26, 29, 30, 31, 32	213	kg/ha
09/11/2020	f	Applied Sulphate of Potash (SOP): Block 2 - Plots 23, 24, 25, 26, 29, 30, 31, 32	140	kg/ha
22/04/2021	f	Applied Nitram: Block 2 - Plots 25, 26, 31, 32	217	kg/ha
22/04/2021	f	Applied Muriate of Potash (MOP): Block 2 - Plots 23, 24, 25, 26, 29, 30, 31, 32	167	kg/ha
22/11/2021	a	Harvest using Amazone Grass Harvester - Flail Mower Collector, JD5070: 2nd Cut	-	-
Grass ley and clover/grass leys (2nd and 3rd year leys)				
09/11/2020	F	Applied Muriate of Potash (MOP): Block 4 - Plots 55, 56, 57, 58, 59, 60, 61, 62; Block 5 - Plots 65, 66, 69, 70, 77, 78, 79, 80	0	kg/ha
09/11/2020	f	Applied Triple Superphosphate (TSP): Block 4 - Plots 55, 56, 57, 58, 59, 60, 61, 62; Block 5 - Plots 65, 66, 69, 70, 77, 78, 79, 80	213	kg/ha
09/11/2020	f	Applied Sulphate of Potash (SOP): Block 4 - Plots 55, 56, 57, 58, 59, 60, 61, 62; Block 5 - Plots 65, 66, 69, 70, 77, 78, 79, 80	140	kg/ha
22/04/2021	f	Applied Nitram: Block 4 - Plots 57, 58, 61, 62; Block 5 - 65, 66, 69, 70	217	kg/ha
22/04/2021	f	Applied Muriate of Potash (MOP): Block 4 - Plots 55, 56, 57, 58, 59, 60, 61, 62; Block 5 – Plots 65, 66, 69, 70, 77 to 80	167	kg/ha
23/06/2021	a	Harvest using Amazone Grass Harvester - Flail Mower Collector JD5070: 1st Cut	-	-
30/06/2021	a	Mowing using JD6620, Mower-Unifarm CM166	-	-
30/06/2021	a	Baling Grass using Claas Baler, JD6620	-	-
22/11/2021	a	Harvest using Amazone Grass Harvester - Flail Mower Collector, JD5070: 2nd Cut	-	-
25/11/2021	a	Baling using Claas Baler, JD6620	-	-

https://doi.org/10.23637/ERADOC-1-271 *pp 39*

W Wheat (test crop 1)

09/11/2020	f	Applied Triple Superphosphate (TSP) using Cascade Spreader, JD6930 : Block 3 - All Plots	127	kg/ha
09/11/2020		Applied MOP as corrective K: Plots 37, 38	10	kg/ha
09/11/2020		Applied MOP as corrective K: Plots 43, 44	30	kg/ha
09/11/2020		Applied MOP as corrective K: Plots 47, 48	120	kg/ha
09/11/2020		Applied MOP as corrective K: Plots 35, 36	160	kg/ha
09/11/2020		Applied MOP as corrective K: Plots 45, 46	220	kg/ha
09/11/2020		Applied MOP as corrective K: Plots 39, 40	250	kg/ha
11/11/2020	a	Ploughed Tillage 20 cm in Stackyard Woburn using WES Dowdeswell 100 Series Five Furrow Plough, JD6620		
13/11/2020	a	Minimum Tillage 10 cm in Stackyard Woburn using WES Power Harrow, JD6620		
24/11/2020	s	Drilled using WES Accord 4m Tyne Drill JD6620: KWS Zyatt - Wheat	400	seeds/m^2
20/04/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Sprinter - ????	3	L/ha
20/04/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Ally Max SX (18768)	42	g/ha
20/04/2021	p	Sprayed using Knight 24m Sprayer, NH T6030: Starane HI-Load HL (16557)	0.6	L/ha
21/04/2021	f	Applied Sulphate of Potash (SOP): Block 3 - All Plots	150	kg/ha
06/05/2021	f	Applied Nitrochalk (27% N): Block 3 - Plots 331, 351, 361, 343, 373, 384, 394, 401, 414, 422, 432, 444, 453, 462, 471, 484	148	kg/ha
06/05/2021	f	Applied Nitrochalk (27% N): Block 3 - Plots 334, 341, 354, 364, 381, 374, 393, 404, 411, 423, 431, 443, 454, 463, 474, 482	444	kg/ha
06/05/2021	f	Applied Nitrochalk (27% N): Block 3 - Plots 333, 344, 352, 362, 371, 382, 391, 402, 413, 421, 433, 442, 451, 481, 464, 473	741	kg/ha
14/05/2021	P	Sprayed using WES 12m Knight Sprayer, WES MF6150: Sprinter - ????	2	L/ha
14/05/2021	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Lentyma XE (19301),	1	L/ha
14/05/2021	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Retengo 200 (19551)	0.4	L/ha
14/05/2021	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Stefes CCC 720 (17731)	1.5	L/ha
25/08/2021	a	Harvesting using Haldrup C-85 2m cut	-	-
02/09/2021	a	Baling using Claas Baler	-	-

W Rye (test crop 2)

09/11/2020	f	Applied Triple Superphosphate (TSP) using Cascade Spreader, JD6930: Block 1 - All Plots	127	kg/ha
10/11/2020	f	Applied Chalk: Block 1 – all plots	5	t/ha
02/12/2020	s	Drilled using WES Accord 4m Tyne Drill, JD6620: Miscani - Oats	400	seeds/m^2
20/04/2021	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Sprinter - ????	3	L/ha
20/04/2021	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Ally Max SX (18768)	42	g/ha
20/04/2021	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Starane HI-Load HL (16557)	0.6	L/ha
21/04/2021	f	Applied Sulphate of Potash (SOP) using Cascade Spreader, JD6930: Block 1 - All Plots	150	kg/ha

https://doi.org/10.23637/ERADOC-1-271 *pp 40*

06/05/2021	f	Applied Nitrochalk (27% N): Block 1 - Plots 014, 021, 034, 043, 054, 061, 074, 084, 094, 102, 113, 123, 134, 143, 152, 163	185	kg/ha
06/05/2021	f	Applied Nitrochalk (27% N): Block 1 - Plots 011, 023, 031, 042, 051, 063, 072, 081, 091, 103, 111, 121, 132, 142, 153, 162	370	kg/ha
06/05/2021	f	Applied Nitrochalk (27% N): Block 1 - Plots 013, 022, 033, 044, 053, 062, 073, 083, 093, 101, 114, 124, 133, 144, 151, 164	556	kg/ha
20/04/2021	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Sprinter - ????	3	L/ha
20/04/2021	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Ally Max SX (18768)	42	g/ha
20/04/2021	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Starane HI-Load HL (16557)	0.6	L/ha
14/05/2021	P	Sprayed using WES 12m Knight Sprayer, WES MF6150: Sprinter - ????	2	L/ha
14/05/2021	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Cello (18290)	1	L/ha
14/05/2021	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Stefes CCC 720 (17731)	1.5	L/ha
25/08/2021	a	Harvesting using Haldrup C-85 2m cut	-	-
02/09/2021	a	Baling using Claas Baler	-	-

Rye (treatment crop)

09/11/2020	f	Applied Triple Superphosphate (TSP) using Cascade Spreader, JD6930: Block 2 - Plots 17, 18, 19, 20, 21, 22, 27, 28	127	kg/ha
02/12/2020	s	Drilled using WES Accord 4m Tyne Drill	400	seeds/m^2
21/04/2021	f	Applied Sulphate of Potash (SOP) using Cascade Spreader, JD6930: Block 2 - Plots 17, 18, 19, 20, 21, 22, 27, 28	150	kg/ha
22/04/2022	f	Applied Nitram (34.5% N) using Cascade Spreader, JD6930: Block 2 – Plots 17, 18, 19, 20, 21, 22, 27, 28	290	kg/ha
20/04/2021	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Sprinter - ????	3	L/ha
20/04/2021	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Ally Max SX (18768)	42	g/ha
20/04/2021	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Starane HI-Load HL (16557)	0.6	L/ha
14/05/2021	P	Sprayed using WES 12m Knight Sprayer, WES MF6150: Sprinter - ????	2	L/ha
14/05/2021	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Cello (18290)	1	L/ha
14/05/2021	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Stefes CCC 720 (17731)	1.5	L/ha
25/08/2021	a	Harvesting using Haldrup C-85 2m cut	-	-
02/09/2021	a	Baling using Claas Baler	-	-

W Oats

09/11/2020	f	Applied Triple Superphosphate (TSP) using Cascade Spreader, JD6930: Block 5 - Plots 67, 68, 71, 72, 73, 74, 75, 76	127	kg/ha
24/11/2020	s	Drilled using WES Accord 4m Tyne Drill JD6620: Mephisto - RYE	350	seeds/m^2
20/04/2021	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Sprinter - ????	3	L/ha
20/04/2021	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Ally Max SX (18768)	42	g/ha
20/04/2021	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Starane HI-Load HL (16557)	0.6	L/ha
21/04/2021	f	Applied Sulphate of Potash (SOP) using Cascade Spreader, JD6930: Block 5 - 67, 68, 71, 72, 73, 74, 75, 76	150	kg/ha

https://doi.org/10.23637/ERADOC-1-271 *pp 41*

22/04/2021	f	Applied Nitram (34.5% N) using Cascade Spreader, JD6930: Plots 67, 68, 71, 72, 73, 74, 75, 76	290	kg/ha
14/05/2021	P	Sprayed using WES 12m Knight Sprayer, WES MF6150: Sprinter - ????	2	L/ha
14/05/2021	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Cello (18290)	1	L/ha
14/05/2021	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Stefes CCC 720 (17731)	1.5	L/ha
25/08/2021	a	Harvesting using Haldrup C-85 2m cut	-	-
25/08/2021	a	Harvesting using Haldrup C-85 2m cut	-	-
02/09/2021	a	Baling using Claas Baler	-	-
W Barley				
09/11/2020	f	Applied Triple Superphosphate (TSP) using Cascade Spreader, JD6930: Block 4 - Plots 49, 50, 51, 52, 53, 54, 63, 64	127	kg/ha
24/11/2020	s	Drilled Libra - Barley	400	seeds/m^2
21/04/2021	f	Applied Sulphate of Potash (SOP) using Cascade Spreader, JD6930: Block 4 - Plots 49, 50, 51, 52, 53, 54, 63, 64	150	kg/ha
22/04/2021	f	Applied Nitram (34.5% N) using Cascade Spreader, JD6930: Plots 49, 50, 51, 52, 53, 54, 63, 64	290	kg/ha
24/11/2020	s	Drilled using WES Accord 4m Tyne Drill JD6620: Libra - Barley	400	seeds/m^2
21/04/2021	f	Applied Sulphate of Potash (SOP) using Cascade Spreader, JD6930: Block 4 - Plots 49, 50, 51, 52, 53, 54, 63, 64	150	kg/ha
25/08/2021	a	Harvesting using Haldrup C-85 2m cut	-	-
02/09/2021	a	Baling using Claas Baler	-	-

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 printed yield books contain an error in some of the mean yields for FYM and NONE treatments.

GRASS TREATMENT CROP

LEYS

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

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

FYM_RES			
LEY	NONE	FYM	MEAN
Lc1	0.00	0.00	0.00
Lc2	4.33	3.69	4.01
Lc3	5.39	5.29	5.34
Ln1	0.00	0.00	0.00
Ln2	7.75	7.05	7.40
Ln3	7.77	6.67	7.22
(LLc/Lc)Lc1	0.00	0.00	0.00
(LLc/Lc)Lc2	3.61	3.80	3.70
(LLc/Lc)Lc3	4.45	4.11	4.28
(LLn/Ln)Ln1	0.00	0.00	0.00

https://doi.org/10.23637/ERADOC-1-271 *pp 42*

(LLn/Ln)Ln2	7.15	6.74	6.95
(LLn/Ln)Ln3	6.82	7.14	6.98
MEAN	3.94	3.71	3.82
1ST CUT MEAN DM%	21.80		

2ND CUT (30 JUN 2020) DRY MATTER TONNES/HECTARE

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

FYM_RES			
LEY	NONE	FYM	MEAN
Lc1	0.51	1.18	0.85
Lc2	1.11	1.18	1.15
Lc3	0.00	0.00	0.00
Ln1	2.55	2.91	2.73
Ln2	1.04	1.53	1.29
Ln3	0.00	0.00	0.00
(LLc/Lc)Lc1	1.75	1.86	1.81
(LLc/Lc)Lc2	1.20	0.93	1.07
(LLc/Lc)Lc3	0.00	0.00	0.00
(LLn/Ln)Ln1	1.62	1.78	1.70
(LLn/Ln)Ln2	1.21	1.19	1.20
(LLn/Ln)Ln3	0.00	0.00	0.00
MEAN	0.92	1.05	0.98
2ND CUT MEAN DM%	32.90		

TOTAL OF 2 CUTS DRY MATTER TONNES/HECTARE

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

FYM_RES			
LEY	NONE	FYM	MEAN
Lc1	0.51	1.18	0.85
Lc2	5.44	4.87	5.16
Lc3	5.39	5.29	5.34
Ln1	2.55	2.91	2.73
Ln2	8.79	8.57	8.68
Ln3	7.77	6.67	7.22
(LLc/Lc)Lc1	1.75	1.86	1.81
(LLc/Lc)Lc2	4.81	4.73	4.77
(LLc/Lc)Lc3	4.45	4.11	4.28
(LLn/Ln)Ln1	1.62	1.78	1.70
(LLn/Ln)Ln2	8.36	7.93	8.15
(LLn/Ln)Ln3	6.82	7.14	6.98
MEAN	4.86	4.75	4.80
TOTAL CUT MEAN DM%	26.20		

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.

https://doi.org/10.23637/ERADOC-1-271 *pp 43*

ARABLE TREATMENT CROPS

RYE

GRAIN (85% DRY MATTER) TONNES/HECTARE

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

FYMRES ROTATION	NONE	FYM	Mean
(ABe)R	4.41	5.28	4.85
(AO)R	5.72	5.23	5.48
(LLn/AO)R	5.54	5.63	5.58
(LLc/ABe)R	3.88	4.53	4.21
Mean	4.89	5.17	5.03
Grain mean DM%	79.90		
Plot area harvested (ha)	0.00393		

WINTER BARLEY

GRAIN (85% DRY MATTER) TONNES/HECTARE

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

FYMRES ROTATION	NONE	FYM	Mean
(ABe)WB	2.50	2.46	2.48
(AO)WB	2.16	2.19	2.18
(LLn/AO)WB	2.43	2.19	2.31
(LLc/ABe)WB	1.86	2.35	2.11
Mean	2.24	2.30	2.27
Grain mean DM%	81.90		
Plot area harvested (ha)	0.00393		

WINTER OATS

GRAIN (85% DRY MATTER) TONNES/HECTARE

Tables of means

FYMRES ROTATION	NONE	FYM	Mean
ABe	2.84	3.25	3.04
AO	3.44	3.19	3.32
LLc/ABe	3.00	3.75	3.38
LLn/AO	3.32	2.83	3.07
Mean	3.15	3.26	3.20
Grain mean DM%	81.30		
Plot area harvested (ha)	0.00393		

ARABLE TEST CROPS

WINTER WHEAT

Grain tonnes/hectare

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

https://doi.org/10.23637/ERADOC-1-271 *pp 44*

FYMRES	none	FYM	Mean
ROTATION			
(AO)W	2.36	4.36	3.36
(ABe)W	3.50	4.19	3.84
(LLn/AO)W	2.19	3.51	2.85
(LLc/ABe)W	4.60	2.55	3.57
(Ln)W	4.50	3.06	3.78
(LLn/Ln)W	4.58	5.33	4.95
(Lc)W	3.85	3.36	3.61
(LLc/Lc)W	4.36	5.22	4.79
Mean	3.74	3.95	3.84

N	0	80	160	240	Mean
ROTATION					
(AO)W	1.45	3.20	4.11	4.65	3.36
((ABe)W	1.99	3.30	5.39	4.69	3.84
(LLn/AO)W	1.89	3.02	3.89	2.59	2.85
(LLc/ABe)W	1.86	3.23	4.17	5.03	3.57
(Ln)W	3.45	3.05	4.08	4.54	3.78
(LLn/Ln)W	3.54	4.54	6.26	5.48	4.95
(Lc)W	1.95	3.57	4.64	4.28	3.61
(LLc/Lc)W	2.93	4.62	5.50	6.11	4.79
Mean	2.38	3.57	4.76	4.67	3.84

N	0	80	160	240	Mean
FYMRES					
none	2.18	3.66	4.57	4.56	3.74
FYM	2.58	3.48	4.94	4.78	3.95
Mean	2.38	3.57	4.76	4.67	3.84

N		0	80	160	240
ROTATION	FYMRES				
(AO)W	none	1.34	2.85	2.16	3.07
	FYM	1.56	3.56	6.06	6.24
(ABe)W	none	1.83	3.06	5.45	3.66
	FYM	2.14	3.53	5.34	5.73
(LLn/AO)W	none	1.46	2.56	2.59	2.15
	FYM	2.33	3.49	5.19	3.02
(LLc/ABe)W	none	2.29	4.62	5.45	6.04
	FYM	1.42	1.85	2.90	4.03
(Ln)W	none	2.71	3.85	5.61	5.82
	FYM	4.19	2.24	2.54	3.26
(LLn/Ln)W	none	3.10	3.77	6.12	5.32
	FYM	3.98	5.30	6.40	5.64
(Lc)W	none	1.88	4.23	4.53	4.78
	FYM	2.02	2.91	4.75	3.77
(LLc/Lc)W	none	2.84	4.33	4.63	5.64
	FYM	3.02	4.92	6.38	6.57
Mean		2.38	3.57	4.76	4.67

Grain mean DM%	79.20
Plot area harvested (ha)	0.00183

WINTER RYE

https://doi.org/10.23637/ERADOC-1-271 *pp 45*

Grain tonnes/hectare

Tables of means

FYMRES	none	FYM	Mean
ROTATION			
(AO)R	4.91	4.81	4.86
(ABe)R	4.95	4.65	4.80
(LLn/AO)R	4.75	5.95	5.35
(LLc/ABe)R	5.48	4.70	5.09
(Ln)R	6.32	6.13	6.24
(LLn/Ln)R	7.83	5.72	6.78
(Lc)R	6.05	4.86	5.46
(LLc/Lc)R	6.51	5.52	6.01
Mean	5.85	5.27	5.56

N	0	50	100	150	Mean
ROTATION					
(AO)R	2.56	4.74	5.44	6.70	4.86
(ABe)R	2.53	4.69	5.53	6.46	4.80
(LLn/AO)R	4.81	5.89	5.90	4.82	5.35
(LLc/ABe)R	3.14	5.34	5.69	6.18	5.09
(Ln)R	5.38	6.29	7.23	6.56	6.24
(LLn/Ln)R	4.28	8.65	7.46	6.71	6.78
(Lc)R	3.50	5.41	6.13	6.78	5.46
(LLc/Lc)R	3.68	5.93	7.00	7.44	6.01
Mean	3.74	5.87	6.23	6.45	5.56

N	0	50	100	150	Mean
FYMRES					
none	3.35	6.62	6.62	6.81	5.85
FYM	4.12	5.11	5.80	6.10	5.27
Mean	3.74	5.87	6.23	6.45	5.56

ROTATION	FYMRES/N	0	50	100	150
(AO)R	none	2.69	4.54	5.35	7.06
	FYM	2.44	4.94	5.53	6.33
(ABe)R	none	2.43	4.66	5.71	7.00
	FYM	2.63	4.71	5.34	5.92
(LLn/AO)R	none	3.08	6.22	6.45	3.26
	FYM	6.53	5.56	5.34	6.38
(LLc/ABe)R	none	3.06	5.17	6.40	7.29
	FYM	3.23	5.52	4.98	5.07
(Ln)R	none	3.97	6.42	7.23	7.66
	FYM	6.78	6.16	-	5.46
(LLn/Ln)R	none	3.93	13.84	7.18	6.35
	FYM	4.64	3.45	7.73	7.08
(Lc)R	none	3.72	5.53	7.24	7.70
	FYM	3.27	5.30	5.02	5.87
(LLc/Lc)R	none	3.92	6.60	7.37	8.15
	FYM	3.45	5.27	6.63	6.73
	Mean	3.74	5.87	6.23	6.45
Grain mean DM%	79.44				
Plot area harvested (ha)	0.00183				

Plot 132 [(Ln)R, FYM, 100 kg N] lost due to combine driver error.

Plots 021-024 [(ABe)R, none] received the same mis-applied N rates as in 2020 (1 3 2 0, rather than 2 0 3 1 that they should have been).

https://doi.org/10.23637/ERADOC-1-271 *pp 46*

21/W/RN/12 WOBURN 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 57th year, Winter Beans.

For previous years see 'Details' 1973 and Yield Books for 74-20/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 in 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 N and nil. From 1995 to 1997 residual effects of that N 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 (white mustard) 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. All application rates of organics are on a fresh weight basis.

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

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

https://doi.org/10.23637/ERADOC-1-271 *pp 47*

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, except for when under winter beans (when no N is applied). For crops receiving N rates rotate as follows:

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

The N0-N5 application rate (per hectare, all applied as Nitro-Chalk 27%N) for each crop are, respectively:

winter rye	0, 30, 60, 90, 120, 150 kg N
spring barley	0, 35, 70, 105, 140, 175 kg N
winter wheat / forage maize	0, 50, 100, 150, 200, 250 kg N

Experimental Diary

Date		Application	Rate	Units
25/10/2020	p	Sprayed using Knight 24m Sprayer, NH T6030: Samurai (16238)	2.5	L/ha
26/10/2020	a	Topping; Topper 9, JD6620	-	-
28/10/2020	f	Applied Farmyard Manure (FYM) by hand: Plots 005, 011, 023, 026	25	t/ha
28/10/2020	f	Applied Farmyard Manure (FYM) by hand: Plots 008, 014, 018, 028	10	t/ha
29/10/2020	f	Applied Straw by hand: Plots 003, 015, 017, 031	7.5	t/ha
29/10/2020	f	Applied Compost by hand: Plots 007, 012, 021, 027	40	t/ha
04/11/2020	a	Topping; WES Topper 9, WES 3m Front Topper, JD6620: Straw Plots	-	-
04/11/2020	a	Ploughed Tillage 20 cm using WES Dowdeswell 100 Series Five Furrow Plough JD6620: Thrown E	-	-
13/11/2020	a	Power Harrow using WES Power Harrow, JD6620	-	-
24/11/2020	s	Drilled using WES Accord 4m Tyne Drill, JD6620: KWS Zyatt	400	seeds/m^2
24/02/2021	a	Topping using Topper 9, JD6620: Grass Plots	-	-
28/04/2021	a	Minimum Tillage 5 cm using Kilworth Power Harrow 1.3 m, Iseki ISTH4335: Marking paths	-	-
05/05/2021	f	Applied Nitrochalk; All Plots except Plots 001, 013, 024, 029	185	kg/ha
05/05/2021	f	Applied Nitrochalk; Sub Plots 024, 032, 045, 053, 065, 073, 084, 093, 106, 116, 126, 146, 155, 163, 171, 185, 193, 202, 215, 226, 235, 256, 266, 272, 282, 304, 311, 325	185	kg/ha
05/05/2021	f	Applied Nitrochalk; Sub Plots 021, 036, 046, 055, 063, 072, 083, 092, 104, 113, 124, 143, 153, 166, 173, 186, 195, 206, 212, 222, 232, 253, 265, 274, 286, 303, 313, 324	370	kg/ha
05/05/2021	f	Applied Nitrochalk; Sub Plots 022, 035, 043, 056, 062, 071, 082, 095, 105, 112, 121, 144, 156, 164, 175, 182, 194, 205, 214, 225, 231, 255, 263, 271, 284, 302, 315, 326	556	kg/ha
05/05/2021	f	Applied Nitrochalk; Sub Plots 025, 033, 044, 054, 064, 076, 085, 091, 102, 111, 123, 142, 154, 162, 176, 181, 192, 201, 211, 223, 236, 252, 262, 273, 283, 305, 312, 323	741	kg/ha
07/05/2021	f	Applied Sulphate of Potash (SOP) using Cascade Spreader, JD6620; All plots except 005, 011, 023, 026	200	kg/ha

https://doi.org/10.23637/ERADOC-1-271 *pp 48*

07/05/2021	f	Applied Triple Superphosphate (TSP) using Cascade Spreader, JD6620; All plots except 005, 011, 023, 026	97.5	kg/ha
18/05/2021	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Sprinter - ????	2	L/ha
18/05/2021	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Ally Max SX (18768)	42	g/ha
18/05/2021	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Lentyma XE (19301)	1	L/ha
18/05/2021	p	Sprayed using WES 12m Knight Sprayer, WES MF6150: Starane HI-Load HL (16557)	0.4	L/ha
23/06/2021	a	Harvest: 1st Cut Grass Plots	-	-
30/06/2021	a	Mowing grass plots using Mower-Unifarm CM166, JD6620	-	-
30/06/2021	a	Topping using WES Topper 9, JD6620	-	-
30/06/2021	a	Baling Grass	-	-
09/08/2021	a	Topping using WES Topper 9, JD6620	-	-
20/08/2021	a	Harvest using Haldrup C-85 2m cut	-	-
24/08/2021	a	Harvested discard areas using Haldrup C-85 2m cut	-	-
02/09/2021	a	Baling using Claas Baler, JD6620	-	-
02/09/2021	a	Topping using WES Topper 9, JD6620	-	-
22/11/2021	a	Harvest: Second Cut Grass Plots	-	-
25/11/2021	a	Topping using WES Topper 9, JD6620	-	-
25/11/2021	a	Baling	-	-

Yields

WINTER WHEAT

N	0	50	100	150	200	250	Mean
ROTATION							
F(Fd)	0.61	2.39	2.73	2.33	2.51	2.45	2.17
F(Ln,Lc6)	0.76	2.25	2.13	1.31	1.72	2.03	1.70
St(St)	0.63	1.76	2.17	2.33	2.13	1.79	1.80
CC(Gm,Lc8)	0.67	1.99	2.83	2.63	2.68	2.52	2.22
Co(Pt,Lc8)	1.71	3.14	3.16	3.09	2.93	3.34	2.89
Dg10(Fs)	0.87	2.51	2.29	2.08	2.44	2.69	2.15
Dg25(Dg)	1.24	3.33	2.91	2.96	3.33	2.59	2.73
Mean	0.93	2.48	2.60	2.39	2.53	2.49	2.24
Grain mean DM%	83.80						

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

https://doi.org/10.23637/ERADOC-1-271 *pp 49*

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	-	-
2021	3.33	1.29	4.63

Cut dry matter t/ha (23 JUNE 2021 AND 22 NOVEMBER 2021).

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

https://doi.org/10.23637/ERADOC-1-271 *pp 50*

Weather Summaries

Rothamsted Research

The Weather : Monthly Summary : 2021

(Departure from the 30 year means (1991 - 2020) in brackets)

	Sunshine		Mean Temperatures °C								Rain			Drainage	Wind ***
			Maximum		Minimum		Dew point	Ground	In ground under grass		Tipping Bucket			20"	
								frosts*	30 cm	100 cm	Total		days**	Total	
	Hours	(hours)	°C	(°C)	°C	(°C)	°C	#	°C	°C	mm	(mm)	#	mm	km/hr
January	52.0	(-11.91)	5.8	(-1.20)	0.4	(-1.22)	1.9	18	5.0	7.2	113.6	(+39.48)	23	88.7	8.6
February	80.8	(-5.38)	8.1	(+0.56)	2.2	(+0.73)	3.1	14	5.2	6.4	45.8	(-11.15)	15	34.0	9.3
March	112.0	(-16.36)	10.7	(+0.42)	3.5	(+0.62)	4.0	18	6.9	7.2	27.6	(-19.47)	13	3.1	9.8
April	215.8	(+43.79)	11.5	(-1.84)	1.1	(-3.36)	1.2	22	8.0	8.1	1.6	(-52.40)	4	0.0	7.9
May	150.4	(-52.92)	14.7	(-1.78)	6.2	(-1.10)	7.1	10	10.7	9.5	94.4	(+41.14)	24	21.4	8.4
June	184.7	(-21.09)	20.3	(+0.77)	11.8	(+1.62)	12.7	0	15.9	12.9	77.6	(+22.78)	11	7.8	6.3
July	195.6	(-11.18)	22.3	(+0.29)	13.4	(+1.04)	14.4	0	17.7	15.0	51.0	(-4.46)	17	5.4	5.9
August	114.2	(-75.21)	19.9	(-1.69)	12.3	(+0.02)	13.3	0	16.9	15.7	37.0	(-34.99)	13	0.1	6.8
September	136.2	(-14.46)	20.6	(+2.08)	11.5	(+1.32)	13.1	0	16.0	15.5	54.1	(-3.60)	11	13.5	5.9
October	95.1	(-17.97)	15.2	(+0.94)	8.6	(+1.01)	9.7	4	13.2	14.0	104.8	(+23.51)	17	55.5	7.1
November	82.1	(+9.89)	10.0	(-0.07)	3.9	(-0.37)	5.0	13	9.8	11.8	19.2	(-62.02)	16	6.3	7.6
December	23.5	(-37.31)	8.6	(+1.16)	3.9	(+1.94)	4.7	9	7.5	9.3	76.2	(+0.58)	24	44.2	8.7
Year	1442.4	(-210.13)	14.0	(-0.03)	6.6	(+0.19)	7.5	108.0	11.1	11.1	702.9	(-60.59)	188.0	280.1	7.7

* Number of nights grass minimum was below 0.0 °C

** Number of days rain was 0.2 mm or more

*** At 2 metres above the ground

https://doi.org/10.23637/ERADOC-1-271 pp 51

https://doi.org/10.23637/ERADOC-1-271

Woburn Experimental Farm

The Weather : Monthly Summary : 2021

(Departure from 30-year means (1991 - 2020) in brackets)

	Sunshine		Mean Temperatures								Rain			Wind ***
			Maximum		Minimum		Dew Point	Ground	In ground under grass		Tipping bucket			
								frosts *	30 cm	100 cm	Total		days **	
	Hours	(hours)	℃	(℃)	℃	(℃)	℃	#	℃	℃	mm	(mm)	#	km/hr
January	44.3	(-15.63)	5.5	(-1.82)	0.5	(-1.04)	1.4	20	4.7	7.6	111.9	(+54.46)	25	8.2
February	81.8	(-1.07)	8.4	(+0.40)	1.4	(-0.02)	2.4	17	5.2	6.8	42.6	(-3.75)	17	8.1
March	104.7	(-21.96)	10.8	(+0.13)	3.1	(+0.45)	3.7	13	6.9	7.3	29.5	(-12.22)	14	9.5
April	214.9	(+47.57)	11.8	(-2.07)	-0.5	(-4.54)	0.9	25	8.2	8.3	6.9	(-43.42)	6	6.5
May	167.6	(-32.90)	15.3	(-1.74)	5.6	(-1.21)	6.5	12	11.6	9.8	120.6	(+66.75)	21	8.2
June	181.4	(-17.20)	20.5	(+0.51)	10.9	(+1.24)	12.2	1	17.2	13.5	70.9	(+19.06)	11	6.2
July	218.7	(+21.05)	23.1	(+0.71)	12.6	(+0.71)	14.2	0	19.2	15.8	75.8	(+24.91)	17	5.9
August	128.7	(-60.99)	20.6	(-1.54)	12.1	(+0.13)	12.9	0	18.0	16.8	24.2	(-37.97)	11	7.5
September	152.3	(+9.02)	21.2	(+2.20)	10.9	(+1.21)	13.0	0	16.7	16.4	48.4	(-8.37)	10	6.1
October	95.3	(-15.24)	15.9	(+1.19)	8.8	(+1.63)	9.6	2	13.4	14.8	83.4	(+9.40)	17	missing
November	68.8	(-0.39)	10.5	(+0.19)	3.4	(-0.65)	5.0	8	9.4	12.4	16.1	(-50.56)	18	missing
December	19.3	(-35.11)	8.8	(+1.16)	3.9	(+2.15)	4.6	4	7.2	9.7	73.1	(+13.91)	25	8.8
Year	1477.9	(-122.86)	14.4	(-0.09)	6.1	(-0.02)	7.2	102.0	11.5	11.6	703.4	(+32.20)	192.0	7.6

* 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

pp 52