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Results of the Classical and Other Long-term Experiments 2021

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Rothamsted Research

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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

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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.

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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

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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.

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(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

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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	-	-

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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	-	-

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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

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Straw Tonnes/Hectare

Tables of means

SECTION	3/W1	4/W1	2/W2	6/W44	0/W17	1/W55	9/W63	8/W5	Mean
PLOT									
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

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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

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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.

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