

Broadbalk Wheat Experiment plan and cropping since 2018

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Date: September 2018, revised June 2021 with addition of cropping details. Updated January 2024 to include nutrient content of FYM.

Description: Experiment plan for the Broadbalk Wheat Experiment, showing fertilizer and manure treatments, crop rotations and the Broadbalk Wilderness (not to scale). Details of fertilizer and manure treatments and cropping since 2018.

- **Page 1:** Cover page
- **Page 2:** Broadbalk Wheat Experiment plan showing plot layout, fertilizer and manure treatments, and the Broadbalk Wilderness. Plan shows crop rotations and fertilizer treatments since 2018.
- **Pages 3-4:** Broadbalk Wheat Experiment fertilizer and organic manure treatments since 1968, with details of amount and type of fertilizer applied.
- **Pages 5-6:** Broadbalk Wheat Experiment cropping details since 1968, showing sections, wheat cultivars and the different rotations.

Site: R/BK/1. Broadbalk field, Rothamsted Experimental Farm, Rothamsted Research, West Common, Harpenden, Hertfordshire, AL5 2JQ, UK. Latitude 51.80946, Longitude -0.37301

Derived from:

- Macdonald et al (2018) *Guide to the Classical and other Long-term Experiments, Datasets and Sample Archive*, Rothamsted Research, Lawes Agricultural Trust Ltd, Harpenden UK.
[10.23637/ROTHAMSTED-LONG-TERM-EXPERIMENTS-GUIDE-2018](https://doi.org/10.23637/ROTHAMSTED-LONG-TERM-EXPERIMENTS-GUIDE-2018)

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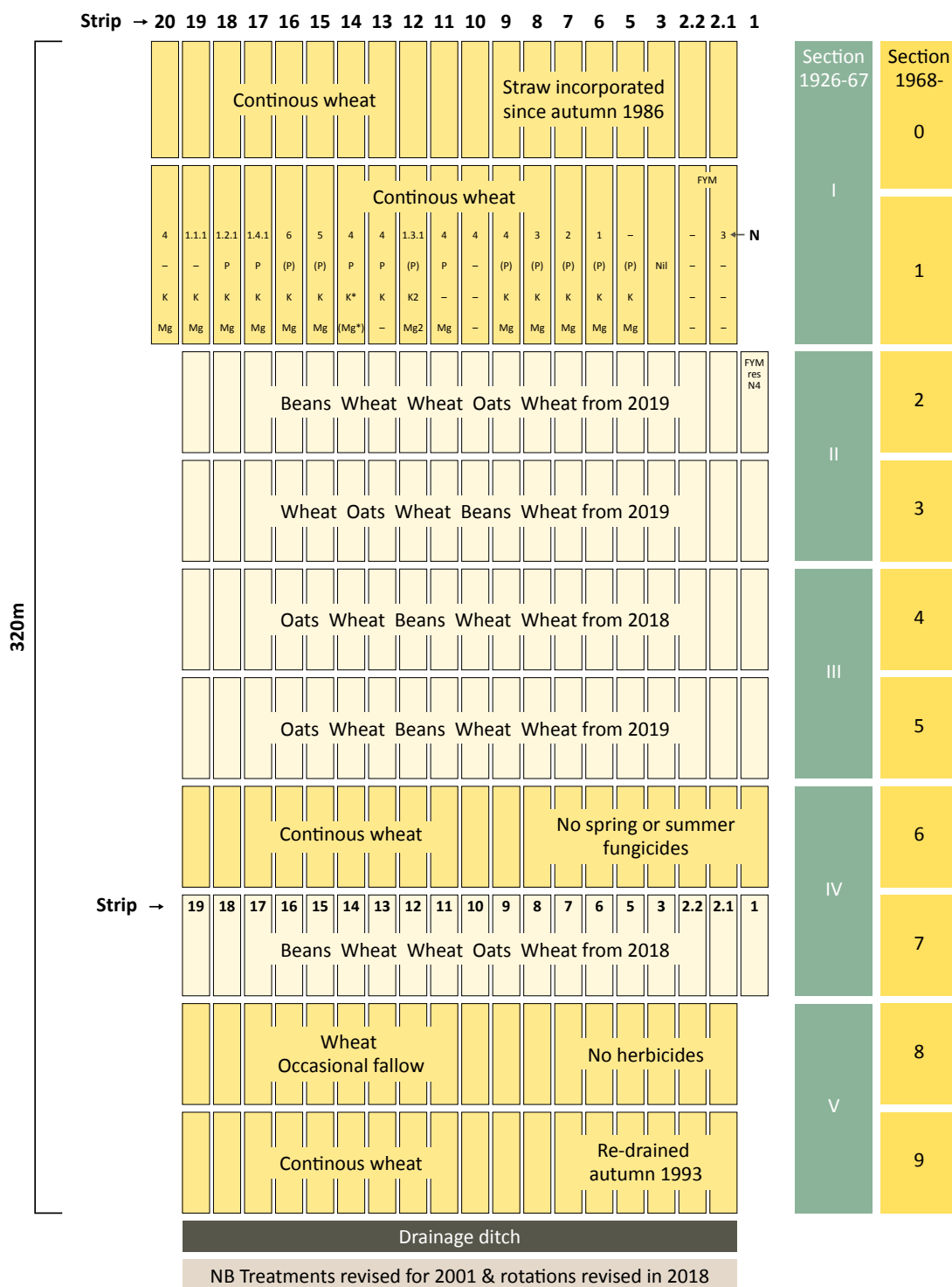
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Broadbalk



Broadbalk fertilizer and organic manure treatments

Strip	1852-1967	1968-1984	1985-2000	2001-2017	from 2021
01	-	FYM N2 PK	FYM N4 PK	(FYM) N4	(FYM) N4
2.1	FYM since 1885	FYM N2	FYM N2	FYM N3 (since 2005)	FYM N3
2.2	FYM	FYM	FYM	FYM	FYM
03	Nil	Nil	Nil	Nil	Nil
05	PKNaMg	PK(Na)Mg	PKMg	(P)KMg	(P)KMg
06	N1 PKNaMg	N1 PK(Na)Mg	N1 PKMg	N1 (P)KMg	N1 (P)KMg
07	N2 PKNaMg	N2 PK(Na)Mg	N2 PKMg	N1 (P)KMg	N1 (P)KMg
08	N3 PKNaMg	N3 PK(Na)Mg	N3 PKMg	N1 (P)KMg	N1 (P)KMg
09	N*1 PKNaMg	N4 PK(Na)Mg	N4 PKMg	N1 (P)KMg	N1 (P)KMg
10	N2	N2	N2	N1 (P)KMg	N1 (P)KMg
11	N2 P	N2 P	N2 P	N4 PMg	N4 (P)Mg
12	N2 PNa	N2 PNa	N2 PNa	N1+3+1 (P)K2Mg2	N1+3+1 (P)KMg
13	N2 PK	N2 PK	N2 PK	N4 PK	N4 (P)K
14	N2 PMg*	N2 PKMg*	N2 PKMg*	N4 PK*(Mg*)	N4 (P)K*(Mg*)
15	N2 PKNaMg	N3 PK(Na)Mg	N5 PKMg	N5 (P)KMg	N5 (P)KMg
16	N*2 PKNaMg	N2 PK(Na)Mg	N6 PKMg	N6 (P)KMg	N6 (P)KMg
17	N2(A)	N2 1/2[PK(Na)Mg]	N0+3 1/2[PKMg](A)	N1+4+1 PKMg	N1+4+1 PKMg
18	PKNaMg(A)	N2 1/2[PK(Na)Mg]	N1+3 1/2[PKMg](A)	N1+2+1 PKMg	N1+2+1 PKMg
19	C	C	(C)	N1+1+1 KMg	N1+1+1 KMg
20	N2 KNaMg since 1906	N2 K(Na)Mg	N2 KMg	N4 KMg	N4 KMg

(A) Treatment to strips 17 & 18 alternating each year. From 1968 both strips received N2 and half-rate PK(Na)Mg; from 1980 wheat on strips 17 & 18 received N1+3 ie autumn N1 in alternate years plus N3 in spring. No autumn N to other crops.

Annual treatment per hectare

FYM : Farmyard manure (from cattle) at 35t
 (FYM) : Farmyard manure at 35t 1968-2000 only
 P : 35kgP as triple superphosphate
 (P) : 35kgP as triple superphosphate until 2000; not applied since 2000 due to high levels of soil P, reviewed annually since 2000. Last applied to plots 11, 13 and 14 in 2020.
 K : 90kgK as potassium sulphate
 K2 : 180kgK as potassium sulphate, 2001-2005. (plus 450 kgK in autumn 2000 only)
 K* : 90kgK as potassium chloride
 Mg : 12kgMg as Kieserite. Was 35kgMg every 3rd year 1974-2000. Previously 11kgMg as magnesium sulphate until 1973
 Mg2 : 24kgMg as Kieserite, 2001-2005. (plus 60 kg Mg in autumn 2000 only)
 (Mg*) : 30kgMg as Kieserite 1974-2000. Previously 31kgMg as magnesium sulphate until 1973
 (Na) : 16kgNa as sodium sulphate until 1973; 55kgNa on strip 12 only until 2000 (57kgNa until 1973)
 (C) : Castor meal to supply 96kgN until 1988

N to wheat as single applications (mid-April)
 N1,N2,N3,N4,N5,N6 : 48,96,144,192,240,288 kgN
 Split N to wheat (mid-March, mid-April, Mid-May)
 N1+1+1 : 48+48+48 kgN (strip 19)
 N1+2+1 : 48+96+48 kgN (strip 18)
 N1+3+1 : 48+144+48 kgN (strip 12)
 N1+4+1 : 48+192+48 kgN (strip 17)

Split N to forage maize, 1997-2017, (seedbed and post-emergence):
 N2+1 : 96+48 kgN (strip 19)
 N2+2 : 96+96 kgN (strip 18)
 N2+3 : 96+144 kgN (strip 12)
 N2+4 : 96+192 kgN (strip 17)

No N or FYM to oats, 1996-2017
 No N or FYM to beans from 2018
 From 2018 N to oats at ½ rate, as a single application (mid-April)
 ½N1, ½N2, ½N3, ½N4, ½N5, ½N6: 24, 48, 72, 96, 120, 144 kgN
 Oats on strips 19, 18, 12 and 17 also receive N as a single application: ½N3, ½N3, ½N5, ½N6 respectively

N applied as ammonium nitrate (Nitram,34.5%N) since 1986;
as calcium ammonium nitrate (Nitro-chalk,21-27.5%N) 1968-85;
as ammonium salts until 1967 except N* which was sodium nitrate

FYM nutrient content:

FYM. The FYM added between 1968-2016 contained, on average (per hectare, per year), 249 kg N, 47 kg P, 333 kg K, 146 kg Ca, 30 kg Mg, 28 kg Na, 42 kg S (analysed 1999-2016 only).

(FYM). The FYM applied to strip 01, 1968-2000, contained, on average, 254 kg N, 44 kg P, 351 kg K, 130 kg Ca, 26 kg Mg, 28 kg Na. S was not analysed until 1999; see value above.

Note : S (sulphur) has been added, by default, as part of the potassium sulphate, magnesium sulphate, Keiserite, FYM and ammonium sulphate applications. **S has not been applied to plot 14 from 2001 onwards.**

Rotations:

In 2018 the rotation sections of the experiment changed to Wheat, Wheat, Oats, Wheat, Beans. The oats will receive N at half of the normal rate (see above); the beans will not receive N or FYM.

In the previous rotation, Wheat, Wheat, Wheat, Oats, Maize from 1996-2017, oats did not receive N or FYM.

In earlier rotations from 1968-1996, beans and potatoes received N, FYM (and PK etc) at the same rate as wheat.

Fallow management:

From autumn 1967 onwards, FYM and the autumn fertilisers (P,K, Na, Mg and Castor meal) were applied to the fallow sections of the rotational sections (and Section 8 when fallowed). N was NOT applied.

This is in contrast to the management of the fallow sections 1926-1967, when no fertilisers or manures were applied to those sections which were fallowed to control weeds in the continuous wheat sections.

Broadbalk Cropping 1968-2023

1st wheat shown in yellow

		New section number									
Wheat cultivar	Harvest Year	Continuous wheat					Rotational wheat				
		1	9	0"	8*	6**	5	3	7	4	2
Cappelle Desprez	1968	W	W	W	W	F	W	W	P	W	BE
Cappelle Desprez	1969	W	W	W	W	W	F	W	BE	P	W
Cappelle Desprez	1970	W	W	W	W	W	W	F	W	BE	P
Cappelle Desprez	1971	W	W	W	W	F	W	W	P	W	BE
Cappelle Desprez	1972	W	W	W	F	W	F	W	BE	P	W
Cappelle Desprez	1973	W	W	W	W	W	W	F	W	BE	P
Cappelle Desprez	1974	W	W	W	W	F	W	W	P	W	BE
Cappelle Desprez	1975	W	W	W	W	W	F	W	BE	P	W
Cappelle Desprez	1976	W	W	W	W	W	W	F	W	BE	P
Cappelle Desprez	1977	W	W	W	W	F	W	W	P	W	BE
Cappelle Desprez	1978	W	W	W	W	W	F	W	BE	P	W
Flanders	1979	W	W	W	W	W	W	F	W	P	F
Flanders	1980	W	W	W	W	W	W	W	F	W	P
Flanders	1981	W	W	W	F	W	W	W	P	F	W
Flanders	1982	W	W	W	W	W	W	W	W	P	F
Flanders	1983	W	W	W	W	W	W	W	F	W	P
Flanders	1984	W	W	W	W	W	W	W	P	F	W
Brimstone	1985	W	W	W	W	W	F	W	W	P	W
Brimstone	1986	W	W	W	W	W	P	F	W	W	W
B & SHM*	1987	W	W	W	W	W*	W	P	W	W	F
B & SHM*	1988	W	W*	W	F	W*	W	W*	F	W	P
B & SHM*	1989	W	W*	W	W	W*	W	W	P	F	W*
B & SHM*	1990	W	W*	W	W	W*	F	W	W*	P	W
Apollo	1991	W	W	W	W	W	P	F	W	W	W
Apollo	1992	W	W	W	W	W	W	P	W	W	F
Apollo	1993	W	W	W	W	W	W	W	F	W	P
Apollo	1994	W	W	W	F	W	W	W	P	F	W
Apollo	1995	W	W	W	W	W	F	W	W	P	W
Hereward	1996	W	W	W	W	W	P	O	W	W	W
Hereward	1997	W	W	W	W	W	W	M	W	W	O
Hereward	1998	W	W	W	W	W	W	W	O	W	M
Hereward	1999	W	W	W	W	W	W	W	M	O	W
Hereward	2000	W	W	W	W	W	O	W	W	M	W
Hereward	2001	W	W	W	F	W	M	O	W	W	W
Hereward	2002	W	W	W	W	W	W	M	W	W	O
Hereward	2003	W	W	F	W	W	W	W	O	W	M
Hereward	2004	W	W	F	W	W	W	W	M	O	W
Hereward	2005	W	W	W	W	W	O	W	W	M	W
Hereward	2006	W	W	W	W	W	M	O	W	W	W
Hereward	2007	W	W	W	W	W	W	M	W	W	O
Hereward	2008	W	W	W	F	W	W	W	O	W	M
Hereward	2009	W	W	W	W	W	W	W	M	O	W
Hereward	2010	W	W	W	W	W	O	W	W	M	W
Hereward	2011	W	W	W	W	W	M	O	W	W	W

Hereward	2012	W	W	W	W	W	W	M	W	W	O
Crusoe ^a	2013	W	W	W	W	W	W	W	O	W	M
Crusoe	2014	W	W	W	W	W	W	W	M	O	W
Mulika ^b	2015	W	W	W	F	W	O	W	W	M	W
Crusoe	2016	W	W	W	F	W	M	O	W	W	W
Crusoe	2017	W	W	W	W	W	W	M	W	W	O
Crusoe	2018	W	W	W	W	W	W	W	Be	O	W
Zyatt	2019	W	W	W	W	W	O	W	W	W	Be
Tyalt ^c	2020	W	W	W	W	W	W	O	W	Be	W
Zyatt	2021	W	W	W	W	W	Be	W	O	W	W
Zyatt	2022	W	W	W	F	W	W	Be	W	W	O
Zyatt	2023	W	W	W	W	W	W	W	Be	O	W

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

"straw incorporated since autumn 1986 *no herbicides **no spring or summer fungicides since 1985

Section 0 fallowed in 2003 and 2004 in an attempt to control *Equisetum* and test various herbicides

B & SHM* comparison of modern variety Brimstone and old variety Squarehead's Master, except on FYM plots
Brimstone in all other sections 1985-1990

^a variety changed to Crusoe in 2013, but sown very late, due to a wet autumn and winter.

^b spring wheat variety Mulika sown in 2015, as wet autumn and winter prevented sowing of winter wheat.

^c spring wheat variety Tyalt sown in 2020, as wet autumn and winter prevented sowing of winter wheat.

Winter wheat varieties selected primarily for their yield potential, and also their suitability for breadmaking.

Continuous wheat: Sections 0, 1, 6, 8 and 9

Section 0 has straw incorporated since 1986

Section 8 has no herbicides, so yields are restricted by weeds. It is fallowed frequently.

Section 6 was in a wheat/wheat/fallow rotation until 1979 and has restricted fungicide use.

Rotational wheat: Sections 2, 3, 4, 5 and 7

These Sections grow wheat in rotation with other arable crops (potatoes, maize, oats, beans & fallow).

Between 1968 and 1980 sections 3, 5 and 6 had a three year rotation of wheat/wheat/fallow.

Section 6 then became continuous wheat.

Between 1968 and 1978 sections 2, 4 and 7 had a three year rotation of wheat/potato/beans.

In 1979 this changed to a three year rotation of fallow/potato/wheat until 1984.

From around 1985 all sections changed to a five year rotation of wheat/wheat/wheat/fallow/potato until around 1996, then wheat/wheat/wheat/oats/maize until 2017.

In 2018 the rotation changed to wheat/wheat/oats/wheat/winter beans. Note there are two first wheats.

Changes to rotation indicated by a thick line.

Other crop cultivars

Spring field beans (*Vicia faba*): 1968-1978: Maris Bead (1968-74); Minor (1975) Minden (1976-78)

Winter field beans (*Vicia faba*) 2018 onwards: Tundra

Potato (*Solanum tuberosum*) 1968-1996: Majestic (1968-69); King Edward (1970-75);

Pentland Crown (1976-93); Estima (1994-96).

Forage maize (*Zea mays*) whole crop for silage: 1997-2017: Hudson (1997-2014); Severus (2015-2017)

Yields may have been reduced due to the accidental application of herbicide to the crop in June/July 2013

Winter oats (*Avena sativa*) 1996 onwards: Image (1996-2000); Revisor (2001), Gerald (2002 onwards)