Broadbalk Wheat Experiment plan and cropping since 2018

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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

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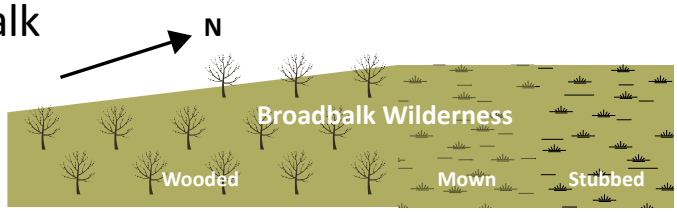
Broadbalk



Strip → 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 3 2.2 2.1 1

320m

	Section 1926-67	Section 1968-
Continous wheat / Straw incorporated since autumn 1986	I	0
Continous wheat: 4 – K Mg / 1.1.1 – K Mg / 1.2.1 P K Mg / 1.4.1 P K Mg / 6 (P) K Mg / 5 (P) K Mg / 4 P K* (Mg*) / 4 P K – / 1.3.1 (P) K2 Mg2 / 4 P – Mg / 4 – – / 4 (P) K Mg / 3 (P) K Mg / 2 (P) K Mg / 1 (P) K Mg / – (P) K Mg / Nil / FYM – – – / 3 – – ← N		1
Beans Wheat Wheat Oats Wheat from 2019 (FYM res N4)	II	2
Wheat Oats Wheat Beans Wheat from 2019		3
Oats Wheat Beans Wheat Wheat from 2018	III	4
Oats Wheat Beans Wheat Wheat from 2019		5
Continous wheat / No spring or summer fungicides	IV	6
Strip → 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 3 2.2 2.1 1 — Beans Wheat Wheat Oats Wheat from 2018		7
Wheat Occasional fallow / No herbicides	V	8
Continous wheat / Re-drained autumn 1993		9

Drainage ditch

NB Treatments revised for 2001 & rotations revised in 2018

Broadbalk fertilizer and organic manure treatments since 1968

Strip	1968-1984	1985-2000	2001-2005	2006-2017	from 2021
01	FYM N2 PK	FYM N4 PK	(FYM) N4	(FYM) N4	(FYM) N4
2.1	FYM N2	FYM N2	FYM N2	FYM N3 (since 2005)	FYM N3
2.2	FYM	FYM	FYM	FYM	FYM
03	Nil	Nil	Nil	Nil	Nil
05	PK(Na)Mg	PKMg	(P)KMg	(P)KMg	(P)KMg
06	N1 PK(Na)Mg	N1 PKMg	N1 (P)KMg	N1 (P)KMg	N1 (P)KMg
07	N2 PK(Na)Mg	N2 PKMg	N2 (P)KMg	N2 (P)KMg	N2 (P)KMg
08	N3 PK(Na)Mg	N3 PKMg	N3 (P)KMg	N3 (P)KMg	N3 (P)KMg
09	N4 PK(Na)Mg	N4 PKMg	N4 (P)KMg	N4 (P)KMg	N4 (P)KMg
10	N2	N2	N4	N4	N4
11	N2 P	N2 P	N4 P Mg	N4 PMg	N4 (P*)Mg
12	N2 P Na	N2 P Na	N1+3+1 (P)K2Mg2	N1+3+1 (P)KMg	N1+3+1 (P)KMg
13	N2 PK	N2 PK	N4 PK	N4 PK	N4 (P*)K
14	N2 PK Mg*	N2 PKMg*	N4 PK*(Mg*)	N4 PK*(Mg*)	N4 (P*)K*(Mg*)
15	N3 PK(Na)Mg	N5 PKMg	N5 (P)KMg	N5 (P)KMg	N5 (P)KMg
16	N2 PK(Na)Mg	N6 PKMg	N6 (P)KMg	N6 (P)KMg	N6 (P)KMg
17	N2 1/2[PK(Na)Mg]	N0+3 1/2[PKMg](A)	N1+4+1 PKMg	N1+4+1 PKMg	N1+4+1 PKMg
18	N2 1/2[PK(Na)Mg]	N1+3 1/2[PKMg](A)	N1+2+1 PKMg	N1+2+1 PKMg	N1+2+1 PKMg
19	C	(C)	N1+1+1 KMg	N1+1+1 KMg	N1+1+1 KMg
20	N2 K(Na)Mg	N2 KMg	N4 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. Maize did not receive autumn N

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 soi reviewed annually

(P*): 35kgP as triple superphosphate until 2020; not applied since 2020 due to high levels of soi reviewed annually

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

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

From 2018 N to oats at ½ rate, as a single application (mid-April)

	31kgMg as magnesium sulphate until 1973	½N1, ½N2, ½N3, ½N4, ½N5, ½N6: 24, 48, 72, 96, 120, 144 kgN
(Na) :	16kgNa as sodium sulphate until 1973; 55kgNa on strip 12 only until 2000 (57kgNa until 1973)	Oats on strips 19, 18, 12 and 17 also receive N as a single application: ½N3, ½N3, ½N5, ½N6 respectively
(C) :	Castor meal to supply 96kgN until1988	No N or FYM to beans from 2018

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

Note : S (sulphur) has been added, by default, as part of the potassium sulphate, magnesium sulphate, Kieserite, FYM and ammonium sulphate applications. **S last applied to plot 14 in 2000.**

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.

Broadbalk Cropping 1968-2021

1st wheat shown in yellow

New section number

		Continuous wheat					Rotational wheat				
Wheat cultivar	Harvest Year	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
Tybalt[c]	2020	W	W	W	W	W	W	O	W	Be	W
Zyatt	2021	W	W	W	W	W	Be	W	O	W	W

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

To select 1st wheat yields, eg Section 7, 1970, in the Data Extraction Tool select Yr-of-wheat = 1
To select 2nd wheat yields, eg Section 7, 1986, in the Data Extraction Tool select Yr-of-wheat = 2
To select 3rd wheat yields, eg Section 7, 1987, in the Data Extraction Tool select Yr-of-wheat = 3

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)