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Details of the Classical and Long-term Experiments 1968-73

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R/BK/1 Broadbalk - Wheat, Potatoes, Beans

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BROADBALK

WHEAT AND THREE COURSE ROTATION

(R/BK/1)

The history of the experiment from the first experimental wheat crop in 1844 to that of 1967 is given in *Details 1967*, pp 11-15 and the *Rothamsted Report for 1968 Part 2*.

Important changes in cropping were introduced for the 1968 crop, the main object being to grow wheat on part of the field after a two year break. Comparisons can therefore be made of the effects of the long continued manurial treatments on wheat in rotation and on continuous wheat. At the same time some modifications were made to the manurial treatments.

Manuring from 1968

- (i) Organic manures and minerals for all crops and for fallow are now applied in autumn before ploughing whereas only farmyard manure was ploughed in previously and no manures or minerals were applied to fallows.
- (ii) All inorganic nitrogen is applied as one dressing in spring and 'Nitro-Chalk' has replaced both sulphate of ammonia and nitrate of soda but is not applied to fallows.

NOTE: A new plot (plot 1) previously untreated receives FYM plus N2PK. Plot 21, formerly 2A, now receives N2 in addition to FYM. Plot 9, previously N1PKNaMg, now receives N4PKNaMg. Plot 14, previously N2PMg, now receives N2PKMg. Plot 15, previously N2PKNaMg, now receives N3PKNaMg. Plots 17 and 18, previously N2 alternating with PKNaMg, now receive N2 and half-rate PKNaMg each year.

Symbols, materials and rates of application (annuals from 1968).

N1, N2, N3, N4.	'Nitro-Chalk' to supply 48, 96, 144, 192 kg N
P	Powdered superphosphate (approx 20% P ₂ O ₅) to supply 34 kg P
K	Sulphate of potash (approx 50% K ₂ O) to supply 90 kg K
Na	Sulphate of soda (approx 14% Na) to supply 16 kg Na (except plot 12, 57 kg Na)
Mg	Sulphate of magnesia (approx 10% Mg) to supply 11 kg Mg (except plot 14, 31 kg Mg)
FYM	35 t farmyard manure
C	Castor meal (approx 5% N) to supply 96 kg N.

Treatments

Plot	Treatments immediately prior to 1968	Treatments from 1968
01	—	DN2PK
21 (formerly 2A)	D	DN2
22 (formerly 2B)	D	D
03	None	None
05	PKNaMg	PKNaMg
06	P1PKNaMg	P1PKNaMg
07	N2PKNaMg	N2PKNaMg

Plot		Treatments immediately prior to 1968	Treatments from 1968
08		N3PKNaMg	N3PKNaMg
09		N1*PKNaMg	N4PKNaMg
10		N2	N2
11		N2P	N2P
12		N2PNa	N2PNa
13		N2PK	N2PK
14		N2PMg	N2PKMg
15		N2 ⁺ PKNaMg	N3PKNaMg
16		N2*PKNaMg	N2PKNaMg
17	even years	PKNaMg	N2+½(PKNaMg)
	odd years	N2	
18	even years	N2	N2+½(PKNaMg)
	odd years	PKNaMg	
19		C	C
20		N2KNaMg	N2KNaMg

* Nitrate of soda + Applied in the autumn

- NOTES: (i) Plot 01 extends over Sections 2-7 (rotation and fallow, wheat, wheat sequences only).
(ii) Plot 20 extends over Sections 0 and 1 (continuous wheat only).

Liming

The liming scheme adopted in 1954 (*Details 1967*, p 14) continued until the autumn of 1967 but no further regular lime was applied in 1969-73.

In autumn 1967 certain plots were given additional dressings of chalk to counteract acidity shown by soil analyses.

Plot	7	8	11	13	14	15
Section 1	—	2.9	—	—	—	—
6, 7	—	8.7	2.9	2.9	—	—
8	2.9	2.9	—	2.9	2.9	2.9
9	2.9	2.9	—	—	—	—

Cropping, fallowing and weed control

- (1) *Crop Sequences*. From 1968 two of the five sections which had already been subdivided (IA and B; VA and B) were allocated to continuous wheat, these sections may be fallowed occasionally to control troublesome weeds but not all in the same season. The remaining three sections (II, III, IV) were divided into halves transversely; three of the smaller sections so formed grow wheat only in a cycle of fallow, wheat, wheat and the other three follow a rotation of potatoes, spring beans and wheat. The ten sections were renumbered:

		Cropping and Fallowing Sequences									
Old section No.		IA	IB	II		III		IV		VA	VB
New section No.		0	1	2	3	4	5	6	7	8	9
Year	1968	17	2	BE	1	3	3	F	P	5	10
	1969	18	3	W	2	P	F	1	BE	6	11
	1970	19	4	P	F	BE	1	2	W	7	12

1971	20	5	BE	1	W	2	F	P	8	13
1972	21	6	W	2	P	F	1	BE	F	14
1973	22	7	P	F	BE	1	2	W	1	15

1, 2, 3 . . first, second, third crop of wheat after fallow, F.

BE = Spring beans, P = potatoes, W = wheat.

Section 8 (VA) continues as hitherto to receive no chemical weedkiller.

(2) *Varieties.*

Wheat: Cappelle: 1969-73 dieldrin dressed (in addition to normal dressing)
 Spring beans: Maris Bead: 1968-70 inoculated with Rhizobium.
 Potatoes: 1968 Majestic, Irish A chitted.
 1969-73 King Edward, once grown chitted from Rothamsted Farm, paracrinkle virus free.

(3) *Weed Control.*

(a) *Use of Chemicals.* All sections carrying wheat have been sprayed as thought necessary each year to control weeds with the exception of section 8 which never receives any weedkiller. Terbutryne and related triazines ('Prebane') has been applied from 1969 onwards to wheat soon after sowing to control blackgrass (*Alopecurus myosuroides*). For many years before 1969 sowing was usually delayed to allow the initial growth of blackgrass seedlings to be destroyed by cultivations.

Simazine was used on the bean crop in 1968 but discontinued thereafter because it damaged beans on plots without organic manures and did not control weeds on plots with them. No weedkillers have been used on this crop since, except paraquat prior to drilling in 1971 to kill fresh growth since autumn cultivations.

(b) *Weedkillers* (Section 8 not treated throughout):

Wheat	1968	Ioxynil with mecoprop
	1969-71 & 1973	Terbutryne; dicamba with mecoprop and MCPA
	1972	Aminotriazole with ammonium thiocyanate (except section 6) to preceding stubble; terbutryne; dicamba with mecoprop and MCPA
Potatoes	1968	None
	1969-73	Linuron with paraquat
	1972	Aminotriazole with ammonium thiocyanate to preceding stubble.

Paraquat was also used in the autumn preceding;

1969	Wheat, potatoes and fallow
1971	Wheat, potatoes and beans

(c) *Mechanical cultivations.* Potato plots have been grubbed and rotary ridged approximately a month after weedkiller applied. The beans have been hoed several times as necessary.

(d) *Hand weeding.* Field horsetail (*Equisetum arvense*) had been

recorded on Broadbalk since 1930 but only became troublesome in the potato crop introduced in 1968 necessitating hand pulling in some years from 1969. Wild oats (*Avena ludoviciana*) have been pulled regularly in the wheat plots, continuing the practice started in 1943. Thistles (*Cirsium arvense*) have been pulled in the wheat in 1968-70.

Other chemicals applied

- (i) Mancozeb has been applied two or three times each year to the potatoes.
- (ii) Demeton-S-methyl has been applied once annually to beans and potatoes to control aphids.
- (iii) 1968, 1970, 1972 & 1973. Potato haulm burnt off with sulphuric acid (Brown Oil of Vitriol).
- (iv) In autumn 1967 3.05 m of the eastern discards of every plot in section 0 was fumigated with methyl bromide at 975 kg and yields were compared in 1968 and 1969 with those from an equal adjoining length receiving normal treatments only.

Plot size

- (i) Wheat: From 1968 a 15-row drill was used and the cropped plot width was reduced from 36 rows (6.40 m) to 30 rows (5.33 m). Plots 21 and 22 originally 20 rows (3.56 m) each now have 22 rows (3.91 m). Rows are 17.8 cm (7 in) apart.
- (ii) Beans: 12 rows drilled in a plot width of 6.40 m, plots 21 and 22 have 7 rows in a plot width of 3.73 m. Rows are 53.3 cm (21 in) apart.
- (iii) Potatoes: 9 rows planted in a plot width of 6.40 m, plots 21 and 22 together have 11 rows in a plot width of 7.82 m. Rows are 71.1 cm (28 in) apart.

Areas manured

Manures, with the exception of 'Nitro-Chalk' continue to be applied to the full, 6.40 m, width for all crops. FYM is applied to plots 21 and 22 as though they were one plot 8.00 m wide. 'Nitro-Chalk' is applied to the drilled area for wheat and to the full width for beans and potatoes except plots 21 and 22 where the treated width is 3.96 m.

Areas harvested

	Wheat (16 rows)	Beans (5 or 6 rows)	Potatoes (4 rows)
Section 0	0.00434		
1	0.00798		
2-7	0.00659	0.00618 (1968, 69, 72)	0.00659
		0.00741 (1970, 71, 73)	
8-9	0.00694		

Soil series Shallow Batcombe series with areas of Batcombe and Hook series.

Reference

Rothamsted Experimental Station. Report for 1968, Part 2.