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00/R/BK/1 Broadbalk - W. Wheat, W. Oats, Forage Maize

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BROADBALK

Object: To study the effects of organic and inorganic manures on continuous w. wheat. From 1968 two three-year rotations were included: potatoes, beans, w. wheat and fallow, w. wheat, w. wheat. In 1979 the first rotation was changed to fallow, potatoes, w. wheat. In 1980 the second rotation reverted to continuous w. wheat. Since 1985 part of the second rotation was added to the first to extend the rotation to fallow, potatoes, w. wheat, w. wheat, w. wheat, in 1996 the fallow was replaced by w. oats and potatoes replaced by maize in 1997.

The 157th year, w. wheat, w. oats and forage maize.

For previous years see 'Details' 1967 and 1973, Station Report for 1966, pp. 229-231, Station Report for 1978, Part 2, Station Report for 1982, Part 2, pp. 5-44 and 74-99/R/BK/1.

Areas harvested:

Wheat:	Section	
	0	0.00366
	1	0.00673
	2,3,6 and 7	0.00556
	8 and 9	0.00585
Oats:	5	0.00556
Maize:	4	0.00162

Treatments:

Whole plots

PLOT

Fertilizers and organic manures:-

	Plot	Treatments until 1967	Treatments from 1968	Treatments from 1985
01DN4PK	01	-	D N2 P K	D N4 P K
21DN2	21	D	D N2	D N2
22D	22	D	D	D
030	03	None	None	None
05F	05	P K Na Mg	P K (Na) Mg	PK Mg
06N1F	06	N1 P K Na Mg	N1 P K (Na) Mg	N1 P K Mg
07N2F	07	N2 P K Na Mg	N2 P K (Na) Mg	N2 P K Mg
08N3F	08	N3 P K Na Mg	N3 P K (Na) Mg	N3 P K Mg
09N4F	09	N*1 P K Na Mg	N4 P K (Na) Mg	N4 P K Mg
10N2	10	N2	N2	N2
11N2P	11	N2 P	N2 P	N2 P
12N2PNA	12	N2 P Na	N2 P Na	N2 P Na
13N2PK	13	N2 P K	N2 P K	N2 P K
14N2PKMG	14	N2 P Mg	N2 P K Mg	N2 P K Mg
15N5F	15	N2 P K Na Mg	N3 P K (Na) Mg	N5 P K Mg
16N6F	16	N*2 P K Na Mg	N2 P K (Na) Mg	N6 P K Mg
17N1+3FH	17	N2 (A)	N2 2(P K (Na) Mg)	N1+3 2(PK Mg) (A)+
18N0+3FH	18	P K Na Mg (A)	N2 2(P K (Na) Mg)	N0+3 2(PK Mg) (A)+
19(C)	19	C	C	(C) (since 1989)
20N2KMG	20	N2 K Na Mg	N2 K (Na) Mg	N2 K Mg

(A) Alternating each year

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+ This change since 1980. Treatments shown are those to w. wheat; autumn N alternates. Maize received N3 2(PK Mg) on both plots 17 and 18.

W. oats; Nitrogen and dung were not applied.

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

Na: 55 kg Na as sulphate of soda

(Na): 16 kg Na as sulphate of soda until 1973

Mg: 30 kg Mg annually to Plot 14 (applied at 26 kg 1990 to 2000), 35 kg Mg every third year to other plots since 1974 (applied at 30 kg in 1991, 1994, 1997 and 2000 and at 15 kg on half rate treatments). All as kieserite since 1974, previously as sulphate of magnesia annually

D: Farmyard manure at 35 t

(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, ten strips of sub-plots (sections) were started with the following cropping:-

SECTION	1/W34	9/W42	0/W49	8/W6	6/W23	5/O	3/W3	7/W1	4/M	2/W2
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

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SECTION

Section	1	9	0*	8+	6**	5	3	7	4	2
Year										
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
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

W = w. wheat, O = w. oats, P = potatoes, BE = s. beans, F = fallow,
M = forage maize

* Straw incorporated since autumn 1986. ** No sprays except weedkillers since 1985. + No weedkillers.

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. None applied since autumn 1991.

Experimental diary:

All sections:

23-Sep-99 : T : PK and Mg applied
24-Sep-99 : T : Na applied.
25-Sep-99 : B : Ploughed.
27-Sep-99 : B : Ploughing completed.
05-Oct-99 : B : Rolled.
12-Jul-00 : B : Hand rogued wild oats.

Cropped sections:

W. wheat:

17-Aug-99 : T : Straw baled (sections 1, 2, 3, 4, 5, 6, 8 and 9).
20-Aug-99 : T : Straw chopped (section 0).
23-Sep-99 : T : Autumn N applied.
24-Sep-99 : T : Farmyard manure applied.
07-Oct-99 : T : Rotary harrowed, Hereward, tr. Sibutol, drilled at 380 seeds/m² with the Accord drill.
13-Mar-00 : T : Hawk at 2.5 l with Tolkán Turbo at 2.0 l, and Cropoil at 1.0 l in 200 l (except section 8).
28-Apr-00 : T : Spring N treatments applied.
09-May-00 : T : Opus at 0.5 l with Unix at 0.5 kg in 100 l (except section 6).
12-May-00 : T : Ally at 30 g with Starane 2 at 0.5 l in 200 l (except section 8).
22-May-00 : T : Policur at 0.75 l in 100 l (except section 6).
12-Aug-00 : T : Combine harvested.

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Experimental diary:

W. oats

07-Oct-99 : T : Rotary harrowed, Image, tr. Sibutol, drilled at 350 seeds/m² with the Accord drill.

15-Nov-99 : T : Lexus 50 DF at 20 g with Toppel 10 at 250 ml in 200 l

11-Mar-00 : T : Orka at 0.5 l in 200 l.

05-Aug-99 : T : Combine harvested.

Forage maize:

24-Sep-99 : T : Farmyard manure applied.

07-May-00 : T : Sting ECO at 4.0 l in 200 l.

01-May-00 : T : Sting CT at 4.0 l in 200 l.

16-May-00 : T : N treatments applied. Flexitined twice, rotary harrowed, Hudson, tr. Mesurol, drilled at 10.2 seeds/m² with the Nodet Gougis drill.

17-May-00 : T : Rolled.

26-Jun-00 : T : Barclay Mutiny at 2.4 l in 200 l.

14-Sep-00 : T : Hand harvested.

NOTE: Samples of wheat and oat, grain and straw, and forage maize were taken for chemical analysis. Unground grain, straw and maize samples from selected treatments were archived. Post-harvest top soil was sampled on all plots for chemical analysis and bulk density, selected plots were sampled to 90 cm for chemical analysis. Soil samples were also archived.

W. WHEAT

GRAIN TONNES/HECTARE

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

SECTION PLOT	7/W1	2/W2	3/W3	8/W6	6/W23	1/W34	9/W42	0/W49
01DN4PK	8.84	9.05	6.79	*	7.66	*	*	*
21DN2	8.16	8.07	5.96	1.38	7.25	8.13	7.35	6.55
22D	5.75	5.65	5.86	1.26	5.39	6.56	5.54	4.94
030	1.12	0.91	0.91	0.28	0.64	0.87	0.73	0.48
05F	1.51	1.01	0.60	0.46	0.48	0.95	0.92	0.53
06N1F	3.56	3.23	1.92	0.67	2.14	3.12	2.82	2.65
07N2F	5.81	4.62	2.65	0.65	3.87	4.84	4.66	3.84
08N3F	7.69	6.91	3.85	1.12	5.27	5.66	4.96	4.88
09N4F	9.14	7.73	2.99	0.84	5.78	6.61	6.51	6.25
10N2	5.00	3.52	1.71	0.74	2.07	2.26	2.13	2.17
11N2P	5.74	5.15	1.85	0.61	2.70	3.28	2.26	3.18
12N2PNA	5.78	5.12	2.28	0.82	3.44	3.70	3.61	3.99
13N2PK	5.58	4.80	2.03	0.98	3.26	4.36	5.52	3.76
14N2PKMG	5.58	4.68	2.21	1.37	3.31	4.65	4.92	4.14
15N5F	9.01	8.35	3.20	1.94	5.75	6.21	7.29	5.76
16N6F	8.46	8.82	5.02	1.18	6.75	6.99	7.79	6.89
17N1+3FH	8.25	7.36	3.46	1.25	5.89	6.42	7.33	6.28
18N0+3FH	7.73	6.93	2.77	0.95	5.97	5.67	7.14	5.09
19(C)	1.47	1.28	1.12	0.60	1.10	1.66	2.12	1.34
20NKMG	*	*	*	*	*	2.06	*	1.90

GRAIN MEAN DM% 84.7

00/R/BK/1 W. WHEAT

STRAW TONNES/HECTARE

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

SECTION PLOT	7/W1	6/W23	1/W34	9/W42
01DN4PK	5.40	*	*	*
21DN2	5.10	4.45	5.96	4.74
22D	4.10	4.42	4.93	4.13
030	0.56	0.28	0.80	0.50
05F	0.87	0.26	0.61	0.59
06N1F	1.74	1.14	1.91	1.75
07N2F	2.50	1.75	2.74	2.62
08N3F	3.10	2.17	3.11	2.55
09N4F	3.87	2.84	3.57	3.22
10N2	1.51	*	1.75	*
11N2P	2.19	*	2.20	*
12N2PNA	1.90	*	2.19	*
13N2PK	2.42	*	2.33	*
14N2PKMG	2.49	*	2.54	*
15N5F	4.20	3.00	3.75	3.94
16N6F	4.42	3.27	3.94	4.29
17N1+3FH	3.42	*	3.46	*
18N0+3FH	3.12	*	2.66	*
19 (C)	0.63	*	0.81	*
20NKMG	*	*	1.21	*

STRAW MEAN DM% 77.1

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GRAIN TONNES/HECTARE

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

PLOT	GRAIN	STRAW
01 (D) (N4) PK	6.64	7.12
21 (D) (N2)	6.14	4.80
22 (D)	6.10	5.49
030	1.67	0.78
05F	1.56	0.58
06 (N1) F	1.95	0.84
07 (N2) F	2.42	1.15
08 (N3) F	2.43	1.03
09 (N4) F	3.48	2.08
10 (N2)	3.34	1.64
11 (N2) P	3.07	1.46
12 (N2) PNA	2.93	1.25
13 (N2) PK	2.28	0.98
14 (N2) PKMG	2.17	0.92
15 (N5) F	3.53	2.39
16 (N6) F	4.70	4.09
17 (N1) +3FH	3.02	1.42
18N0+3FH	3.58	2.16
19 (C)	2.37	1.07

GRAIN MEAN DM% 86.6

STRAW MEAN DM% 83.1

NOTE: Dung and nitrogen treatments are residual from previous wheat.

MAIZE

WHOLE CROP (100% DM) TONNES/HECTARE

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

PLOT	WHOLE CROP
01DN4PK	12.80
21DN2	10.34
22D	9.70
030	1.98
05F	2.40
06N1F	6.05
07N2F	9.55
08N3F	10.78
09N4F	10.77
10N2	3.99
11N2P	5.83
12N2PNA	6.34
13N2PK	9.27
14N2PKMG	10.63
15N5F	11.76
16N6F	13.75
17N3FH	10.89
18N3FH	10.59
19 (C)	2.97

CROP MEAN DM% 23.7