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04/R/BK/1 - Broadbalk

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BROADBALK

Object: To study the effects of organic manures and inorganic fertilisers on w. wheat. From 1968 two three-year rotations were included: continuous 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 160th 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 1968, Part 2; Station Report for 1982, Part 2, pp. 5-44 and 74-03/BK/1.

Areas harvested:

Wheat:	Section	
	1	0.00589
	2,3,5 and 6	0.00487
	8,9	0.00512
Oats:	4	0.00487
Maize:	7	0.00162

Treatments:

In 2001 a number of the treatments were changed. The treatments are now: -

Whole plots

PLOT	Fertilize Treatment	ers and organic manures
	Plot	from 2001
01 (FYM) N4	01	N4
21FYMN2	2.1	FYM N2
22FYM	2.2	FYM
03Nil	03	None
05(P)KMg	05	(P) K Mg
06N1(P)KMg	06	N1 (P) K Mg
07N2(P)KMg	07	N2 (P) K Mg
08N3(P)KMg	08	N3 (P) K Mg
09N4(P)KMg	09	N4 (P) K Kg
10N4	10	N4
11N4PMg	11	N4 P Mg
12N1+3+1(P)K2Mg2	12	N1+3+1 (P) K2 Mg2
13N4PK	13	N4 P K
14N4PK* (Mg*)	14	N4 P K* (Mg*)
15N5(P)KMg	15	N5 (P) K Mg
16N6(P)KMg	16	N6 (P) K Mg
17N1+4+1PKMg	17	N1+4+1 P K Mg
18N1+2+1PKMg	18	N1+2+1 P K Mg
19N1+1+1KMg	19	N1+1+1 K Mg
20N4KMg	20	N4 K Mg

W. oats; Nitrogen and farmyard manure were not applied. 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 nitrogen plots for wheat and to the seedbed for forage maize. Split N to wheat N1+1+1, 1+2+1 etc: Rates as above. Timings: first two weeks of March, GS31 or mid-April (whichever comes first) and GS37/mid-May. Split N to forage maize N2+1, 2+2, 2+3, 2+4: Rates as above. Timings: to the seedbed and postemergence. P: 35 kg P as triple superphosphate. (P): (none), to be reviewed in 2004/5. K: 90 kg K as potassium sulphate. K2: 180 kg K as potassium sulphate (plus 450 kg K autumn 2000 only). 90 kg K as potassium chloride. K*: Mg: 12 kg Mg as kieserite. 24 kg Mg as kieserite (plus 60 kg Mg, autumn 2000 only). Mg2: (none), to be reviewed in 2004/5. (Mg*): FYM: Farmyard manure at 35 t

Previous treatment: -

Whole plots

PLOT		Fertilizers	and organic manures:-	
		Treatments	Treatments	Treatments
	Plot	until 1967	from 1968	from 1985 - 2000
01DN4PK	01	-	DN2 PK	DN4 PK
21DN2	21	D	D N2	D N2
22D	22	D	D	D
030	03	None	None	None
05F	05	P K Na Mg	РК (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 PK	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 ½[P K (Na) Mg]	N1+3 ½[PK Mg] (A)+
18N0+3FH	18	P K Na Mg(A)	N2 ½[P K (Na) Mg]	N0+3 ½[PK Mg] (A)+
19(C)	19	С	С	(C) (since 1989)
20N2KMG	20	N2 K Na Mg	N2 K (Na) Mg	N2 K Mg

(A) Alternating each year

- + This change since 1980. Treatments shown are those to w. wheat; autumn N alternates. Maize received N3 ½[PK Mg] on both plots 17 and 18. These treatments shown incorrectly in 1999-02 Yield books.
- 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
 - 16 kg Na as sulphate of soda until 1973 (Na):
 - 30 kg Mg annually to Plot 14 (applied at 26 kg 1990 to Mg: 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 subplots (sections) were started with the following cropping:-

1	9	0*	8+	6**	5	3	7	4	2
W	W	W	W	F	W	W	Р	W	BE
W	W	W	W	W	F	W	BE	Р	W
W	W	W	W	W	W	F	W	BE	P
W	W	W	W	F	W	W	Р	W	BE
W	W	W	F	W	F	W	BE	Р	W
W	W	W	W	W	W	F	W	BE	Р
W	W	W	W	F	W	W	Р	W	BE
W	W	W	W	W	F	W	BE	P	W
W	W	W	W	W	W	F	W	BE	Ρ
W	W	W	W	F	W	W	Р	W	BE
W	W	W	W	W	F	W	BE	Р	W
W	W	W	W	W	W	F	W	Р	F
W	W	W	W	W	W	W	F	W	Р
W	W	W	F	W	W	W	Р	F	W
W	W	W	W	W	W	W	W	Р	F
W	W	W	W	W	W	W	F	W	Р
W	W	W	W	W	W	W	P	F	W
W	W	W	W	W	F	W	W	P	W
W	W	W	W	W	Ρ	F	W	W	W
W	W	W	W	W	W	Р	W	W	F
W	W	W	F	W	W	W	F	W	P
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SECTION		0	0 -	0.1	C + +	F	n	7	4	2	
Section	1	9	0*	8+	6**	5	3	/	4	4	
lear							7.7	D		T.7	
989	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	
L993	W	W	W	W	W	W	W	F	W	P	
1994	W	W	W	F	W	W	W	P	F	W	
L995	W	W	W	W	W	F	W	W	P	W	
L996	W	W	W	W	W	P	0	W	W	W	
L997	W	W	W	W	W	W	M	W	W	0	
L998	W	W	W	W	W	W	W	0	W	M	
1999	W	W	W	W	W	W	W	M	0 M	W	
2000	W	W	W	W	W	0	W	W	M	W	
2001	W	W	W	F	W	M	0	W	W	W	
2002	W	W	W	W	W	W	M	W	W	0	
2003	W	W	F	W	W	W	W	0	W	M	
2004	W	W	F	W	W	W	W	М	0	W	
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(2) 1	For a From a cycle. Year 3 five-y Section Year 5	fuller autumn Year S: Sect year cy ons 2,8	r recor 1975 t to all 1: Se tions O ycle wa 3. Yea tions O	d of t o autu plots ections 0,4,5. as used ar 3: S 0,5. N	mn 1986 in set 1,2,3. From a . Year ections one app	yean Yean Tir Se 7,9.	lk was Section r 2: Se 1988 u ections Year since a	applied s on a t actions 6 intil aut a 1,3. 4: Section utumn 19	at 2 chree 5,7,8 cumn Zear Lons 991.	e-yea 3,9. 1992 2: 4,6.	r a
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(2) 1 (3) (3) Experimental All sections 03-Sep-03 23-Sep-03 23-Sep-03 25-Sep-03 29-Sep-03 23-Feb-04 24-May-04 22 Jun-04	For a From a each a cycle. Year 3 five-y Sectio Year 5 In 200 invest diary : K* P FYM MG MG2 K K2	fulles nutumn Year Sectors 2,8 Sectors 2,8	d (excl state of to all c 1: Se cions 0 ycle wa cions 0 2004 s add (excl state of t 170 f t 35.0 hed 25 pressed rite at ate of ate of ate of ate of ate of ate pat ate pat	d of t co autu plots ctions (,4,5. as used ar 3: S (),5. N section cerent uding 3.0 1 i potash cg, str tonnes cm wid d, not t 80 kg x 20. c 160 k potash 18, 19 potash ths.	mn 1986 in set 1,2,3. From a . Year ections one app 0 was herbici section n 200 I at 181 -ips 11, , strip le furro to sect f, strip at 217 & 20. h at 434	<pre>chains of s Year utumn f 1: So a 7,9. olied s used f des to h 0). (exc kg, s 13, os 2.1 ows, c cion 0 os 5, ip 12. 7 kg,</pre>	lk was Section r 2: Se 1988 u ections Year since a for an o contr luding trip 14 14, 17, & 2.2, ultipre 6, 7, 8 strips	applied as on a t ections 6 intil aut a 1,3. Y 4: Section to Equin section Equin section t. & 18. not to essed, no 3, 9, 11	at 2 chree 5,7,8 cumn Zear ions 991. ent (setun 0 & Sect ot to , 15,	<pre>-yea 3,9. 1992 2: 4,6. (CS/5 n arv 8). sion c sec , 16,</pre>	r a 95) <i>rense</i> 0 or tion 17,
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Experimental diary:

Winter wheat 30-Sep-03	Combination drilled, Hereward, tr. Sibutol Secur, at 350
-	seeds/m ² with the Accord drill. Rolled.
05-Dec-03	tm)Lexus Class WSB at 60 g in 200 l, excluding section 8. tm)Hallmark with Zeon Technology at 50 ml in 200 l,
	excluding section 8.
18-Dec-03	Arelon 500 at 3.5 1 in 200 1, excluding section 8.
09-Apr-04 17-Mar-04	<pre>tm)Topik at 3.5 l in 200 l, excluding section 8. tm)Amber at 0.5 l in 200 l, excluding section 8. 1st split N applied.</pre>
06-May-04	tm)Ally at 30 g in 200 l, excluding section 8. tm)Starane 2 at 0.7 l in 200 l, excluding section 8.
07-May-04	Main N and 2 nd split N applied.
13-May-04	Landmark at 1.0 1 in 200 1, excluding Section 6.
25-May-04	3 rd split N applied.
10-Jun-04	tm)Opera at 1.0 l in 200 l, excluding Section 6. tm)Hallmark with Zeon Technology at 50 ml in 200 l, excluding section 6.
16-Aug-04	Combine harvested discards, swathed straw.
02-Sep-04	Combine harvested plots for yield. Swathed straw. (except section 8).
03-Sep-04	Combine harvested discards, swathed straw. Combine harvested section 8. (Wheat badly laid, not all plots harvested).
	Sampled and weighed straw. Combine harvested discards.
04-Sep-04	Baled straw.
N. oats	
30-Sep-03	Combination drilled, Gerald, tr. Sibutol Secur, at 350 seeds/m ² with the Accord drill. Rolled.
05-Dec-03	tm)Lexus Class WSB at 60 g in 200 l. tm)Hallmark with Zeon technology at 50 ml in 200 l.
06-May-04	tm)Ally at 30 g in 200 l tm)Starane 2 at 0.7 l in 200 l
13-May-04	Landmark at 1.0 l in 200 l.
03-Sep-04	Combine harvested discards, swathed straw. Combine harvested plots for yield. Swathed straw. Sampled and weighed straw.
04-Sep-04	Baled straw.
Forage maize	
09-Apr-04	Glydate at 3.0 1 in 200 1.
13-May-03	Main N and 1 st split N applied.
14-May-04	Flexitined.
19-May-04	Power harrowed.
20-May-04 17-Jun-04	Drilled, Hudson, tr. Mesurol at 10.2 seeds/m ² , with the Node Gougis drill. 2 nd split N applied.
22-Jun-04	Samson at 1.5 1 in 200 1.
20-Sep-04	Cut sample areas by hand, weighed, and sampled.
21-Sep-04	Cleared maize.
Section 0	cicalca maize.
06-Jul-04	Weedazol-TL at 30 1 in 200 1 to plots not being used for CS/595 Control of Equisetum.
06-Jul-04	Treatments applied to CS/595.
	Treatments applied to CS/595.
09-Sep-04	

OTE: Straw on Section 0 was balled and removed at harvest 2002 (usually incorporated) as this section will remain unploughed to test control of Equisetum. Samples of wheat and oat grain and straw, and forage maize were taken for chemical analysis. Unground wheat grain and straw and maize samples from selected treatments were archived.

1

04/R/BK/1

WHEAT

GRAIN TONNES/HECTARE

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***** Tables of means *****
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						V	3
SECTION	2/W1	3/W2	5/W3	8/W3	6/W27	`1/W38	9/W46
PLOT							
01(FYM)N4	9.20	7.33	6.84	*	7.25	*	*
21FYMN2	9.06	7.30	7.06	nh	6.92	6.09	5.93
22FYM	6.44	4.40	4.17	nh	4.38	4.04	4.29
03Nil	1.29	1.09	1.27	0.52	1.26	0.71	0.13
05(P)KMg	1.52	1.47	0.97	0.82	1.29	1.11	0.85
06N1(P)KMg	3.76	2.85	2.23	1.32	2.84	2.83	2.73
07N2(P)KMg	5.61	4.25	2.85	1.75	3.84	4.09	3.72
08N3(P)KMg	7.35	4.73	2.57	1.32	3.73	4.50	4.17
09N4 (P) KMg	8.35	6.54	5.50	2.04	6.03	5.78	5.82
10N4	5.45	2.35	4.10	0.68	0.79	2.26	0.12
11N4PMg	6.98	5.23	4.33	1.44	5.22	4.86	5.07
12N1+3+1(P)K2Mg2	8.05	7.02	6.17	0.90	7.68	5.78	6.08
13N4PK	7.25	5.85	3.28	1.64	6.32	5.17	3.91
14N4PK*(Mg*)	7.05	5.47	3.36	1.60	6.44	5.17	4.88
15N5(P)KMg	8.62	5.95	4.02	1.09	5.61	3.43	4.29
16N6(P)KMg	8.45	6.68	6.47	1.50	7.45	6.43	6.92
17N1+4+1PKMg	8.80	7.94	7.23	nh	8.06	6.06	7.37
18N1+2+1PKMg	8.08	6.61	6.72	nh	7.12	5.27	6.23
19N1+1+1KMg	6.74	5.67	5.03	nh	4.62	4.03	3.93
20N4KMg	*	*	*	*	*	1.86	*

GRAIN MEAN DM% 87.2

STRAW TONNES/HECTARE

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

SECTION PLOT	2/W1	8/W3	1/W38
PLOT 01 (FYM) N4 21FYMN2 22FYM 03Ni1 05 (P) KMg 06N1 (P) KMg 07N2 (P) KMg 08N3 (P) KMg 09N4 (P) KMg 10N4 11N4PMg 12N1+3+1 (P) K2Mg2 13N4PK 14N4PK* (Mg*) 15N5 (P) KMg 16N6 (P) KMg 17N1+4+1PKMg	3.71 4.71 3.45 0.25 0.52 1.37 1.78 2.45 3.19 1.88 1.95 3.74 2.72 2.48 3.15 2.92 3.89	* nh nh 0.17 1.02 2.23 1.60 3.45 0.99 2.94 2.94 2.94 2.94 2.94 2.97 2.78 5.98 nh	* 2.62 2.35 0.11 0.28 1.50 1.32 1.60 2.02 1.14 1.88 3.28 1.93 2.01 1.38 2.73 3.44
18N1+2+1PKMg 19N1+1+1KMg 20N4KMg	3.75 2.83 *	nh nh *	2.83 2.71 0.48

STRAW MEAN DM% 89.2

Note: nh = not harvested

W. OATS

GRAIN TONNES/HECTARE

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

PLOT	GRAIN	STRAW
01(FYM)[N4]	6.07	2.80
21[FYMN2]	6.52	3.38
22[FYM]	6.69	3.11
03Nil		0.29
05(P)KMg	2.37	0.34
06[N1](P)KMg	3.06	0.71
07[N2](P)KMg	3.48	0.89
08[N3](P)KMg	3.80	0.91
09[N4](P)KMg	4.03	1.27
10[N4]	4.64	1.65
11 [N4] PMg	5.41	2.02
12[N2](P)K2Mg2	4.75	1.51
13[N4]PK	4.41	1.45
14[N4]PK*(Mg*)	4.43	1.37
15[N5](P)KMg	5.55	2.24
16[N6](P)KMg	6.12	2.65
17[N1+4+1]PKMg	5.77	2.43
18[N1+2+1]PKMg	4.09	1.23
19[N1+1+1]KMg	3.47	0.98
MEAN DM%	85.5	91.7

FORAGE MAIZE

WHOLE CROP (100% DM) TONNES/HECTARE ***** Tables of means ***** PLOT WHOLE CROP 01(FYM)N4 23.13 21FYMN2 17.55 22FYM 16.78 1.56 03Nil 05(P)KMg 0.97 06N1(P)KMg 3.27 11.97 07N2(P)KMg 08N3(P)KMg 15.13 09N4(P)KMg 16.12 10N4 5.33 9.31 11N4PMg 12N2+3(P)K2Mg2 13.67 13N4PK 13.65 14N4PK*(Mg*) 13.76 15N5(P)KMg 13.67 13.60 16N6(P)KMg 17N2+4PKMg 13.00

CROP MEAN DM% 27.5

18N2 + 2 PKMg

19N2+1KMg

16.89

5.86