ROTHAMSTED RESEARCH

Yields of the Field Experiments 1984

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84/S/RN/1 Rotation I - Grass, W. Beans, W. Wheat, S. Barley

Rothamsted Research

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84/S/RN/1

ROTATION I

Object: To compare nutrient cycles, uptakes of nutrients and responses to fresh P and K. To obtain an estimate of the rate of release of nutrients, particularly K, from Saxmundham soil - Saxmundham.

Sponsor: A.E. Johnston.

The 85th year, grass, w. wheat, w. beans, s. barley.

For previous years see 'Details' 1967 and 1973, and 74-83/S/RN/1.

Whole plot dimensions (original treatments): 5.49 x 40.2.

Treatments: From 1899 to 1969 the experiment followed a four-course rotation of w. wheat, roots, s. barley, legumes. Each phase of the rotation was present each year on a separate block. From 1966 each plot was divided. A small area at the south end continued under the original treatment until 1979, these plots were sown to grass in 1970, the treatments were discontinued after 1979 and yields no longer taken although the plots remain in grass. Modified treatments (NEWTREAT) were applied on the larger sub-plots from 1966 (see below).

In 1970 the rotation was stopped and each pair of blocks was divided for lucerne and grass (the original treatment sub-plots formed part of the grass area). In 1977 lucerne was ploughed on one pair of blocks to start an arable rotation testing fresh K to plots previously given none since 1899 (S/RN/1-2). In 1978 lucerne on the other pair of blocks was replaced by a grass/clover mixture; this was ploughed in 1979 for a continuing test of subsoil loosening and incorporation of PK to the subsoil (S/RN/1-3).

Since autumn 1980 the four sections of NEWTREAT grass have been ploughed up progressively to start a sequence of arable crops (S/RN/1-1) measuring the effects of soil K depletion. The sequence of crops has been:

Section	1970-80	1981	1982	1983	1984
(a)	G	W	BE	W	W
(b)	G	G	G	BE	W
(c)	G	G	G	G	BE
(d)	G	G	G	G	G

G = NEWTREAT grass, W = w. wheat, BE = w. beans.

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Treatments to crops in these sections were:

TREATMENT 1899-1965	NEWTREAT Grass 1966-1984	W. wheat and w. beans 1984
	MANURE	MANURE
D	(D)N	(D)P2
B	BN	B
N	(N)P2N	(N)P2
P	(P)P1N	(P)P1
K	(K)P2KN	(K)P2K
-	(-)P2N	(-)P2
PK	(PK)P1KN	(PK)P1K
NK	(NK)P2KN	(NK)P2K
NP	(NP)P1N	(NP)P1
NPK	(NPK)P1KN	(NPK)P1K

D: Farmyard manure at 15 tonnes
(D): Farmyard manure at 30 tonnes, 60 tonnes in autumn 1969, none since.
B: Bone meal at 0.5 tonnes
N: 1899-1965, 38 kg N as nitrate of soda. Since 1970, 100 kg N as 'Nitro-Chalk' per cut of grass
P: 1899-1965, 40 kg P_2O_5 as single superphosphate. 1966-79, 50 kg P_2O_5 as triple superphosphate
P1,P2: 50, 100 kg P_2O_5 as triple superphosphate
K: 1899-1965, 63 kg K_2O as muriate of potash. Since 1966, 126 kg K_2O

W. wheat in Sections (a) and (b) tested in addition to MANURE all the combinations with the following nitrogen rates (kg N) applied in spring as 'Nitro-Chalk' (40 kg N applied on 9 March, 1984, remainder on 10 Apr):

N(NC)
120
160
200
240

Part of the w. wheat in Section (b) tested in addition to MANURE all the combinations with the following nitrogen rates (kg N) applied on 17 Apr as prilled urea:

N(PU)
0
160
200

NOTE: All w. wheat in Sections (a) and (b) was given 50 kg N to the seedbed, as prilled urea, in addition to the spring nitrogen rates.

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S/RN/1-2 tested all combinations of the following:

Whole plots

1. MANURE — Manures as defined above for arable crops:

Sub plots

2. K — Potassium (kg K_2O) as muriate of potash, total applied 1977-80

   0
   440

3. N — Nitrogen fertilizer (kg N) in spring as 'Nitro-Chalk' in addition to 50 kg N to the seedbed, as prilled urea:

   40+120 — 40 on 9 March, 1984 + 120 on 10 Apr
   40+160 — 40 on 9 Mar + 160 on 10 Apr

S/RN/1-3 tested all combinations of:

Whole plots

1. MANURE — Manures as defined above for arable crops:

Sub plots

2. TREATMNT — Cultivations etc in May, 1979 only:

   CNVNTIAL — Conventional, mouldboard ploughed
   SUBDUG — Subsoil dug by Wye double digger
   SUBDUG+F — Subsoil dug by Wye double digger incorporating 374 kg P and 712 kg K (as 0:20:20) into the subsoil at time of working

3. N — Nitrogen fertilizer (kg N) as 'Nitro-Chalk':

   30+30 — 30 on 19 Mar, 1984, 30 top dressed on 10 Apr
   30+60 — 30 on 19 Mar, 1984, 60 top dressed on 10 Apr
   30+90 — 30 on 19 Mar, 1984, 90 top dressed on 10 Apr
   30+120 — 30 on 19 Mar, 1984, 120 top dressed on 10 Apr

Standard applications:

W. wheat, on S/RN/1-1 and S/RN/1-2. Weedkillers: Chlortoluron at 2.5 kg with mecoprop, bromoxynil and ioxynil (as 'Brittox' at 3.5 l) applied with the permethrin in 220 l. Mecoprop, bromoxynil and ioxynil (as 'Brittox' at 2.1 l) in 220 l applied with the prochloraz. Fungicides: Prochloraz at 0.40 kg. Carbendazim at 0.15 kg with maneb at 1.6 kg and tridemorph at 0.37 kg plus captafol at 1.1 kg applied with the pirimicarb in 220 l. Insecticides: Permethrin at 0.06 kg. Pirimicarb at 0.14 kg.

W. beans, on S/RN/1-1: Weedkiller: Simazine at 1.1 kg in 220 l. Fungicide: Benomyl at 0.56 kg in 220 l.

Grass, on S/RN/1-1: Manures: N at 100 kg on two occasions, as ammonium nitrate on the first as 'Nitro-Chalk' on the second.

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S. barley, on S/RN/1-3: Manures: N at 30 kg, as ammonium nitrate. Fungicides: Carbendazim at 0.15 kg, maneb at 1.6 kg and tridemorph at 0.37 kg with the pirimicarb in 220 l. Insecticide: Pirimicarb at 0.14 kg.

Seed: W. wheat: Norman, sown at 200 kg.
W. beans: Banner, sown at 250 kg.
S. barley: Triumph, seed dressed with triadimenol and fuberidazole, sown at 190 kg.

Cultivations, etc.:-
W. wheat: P, K and bonemeal treatments applied: 30 Aug, 1983. Ploughed: 9 Sept. Power harrowed, seed sown, seedbed N as prilled urea applied: 27 Sept. Chlortoluron, 'Brittox' and permethrin applied: 19 Oct. 'Brittox' with prochloraz applied: 17 Apr. Carbendazim, maneb, tridemorph, captafol and pirimicarb applied: 27 June. Combine harvested: 21 Aug.
W. beans: P, K and bonemeal treatments applied: 30 Aug, 1983. Ploughed: 13 Sept. Power harrowed, seed sown: 18 Oct. Weedkiller applied: 19 Oct. Fungicide applied: 17 Apr, 1984. Combine harvested: 9 Oct.
Grass section: P, K and bonemeal treatments applied: 31 Aug, 1983. First N, applied: 19 Mar, 1984. Cut: 11 June. Second N applied: 22 June. Cut: 23 Aug.
S. barley: P, K and bonemeal treatments applied: 31 Aug, 1983. Ploughed: 9 Sept. Power harrowed, seed sown: 19 Mar, 1984. Fungicides and insecticide applied: 22 June. Combine harvested: 22 Aug.

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GRASS

DRY MATTER: TONNES/HECTARE

***** TABLES OF MEANS *****

MANURE	1ST CUT(11/6/84)	2ND CUT(23/8/84)	TOTAL OF 2 CUTS
(D)N	2.03	1.94	3.97
BN	1.50	1.53	3.03
(N)P2N	1.71	1.45	3.16
(P)P1N	1.32	1.74	3.06
(K)P2KN	1.73	2.85	4.58
(-)P2N	1.42	1.77	3.19
(PK)P1KN	1.80	2.50	4.30
(NK)P2KN	1.82	2.53	4.35
(NP)P1N	1.43	1.45	2.88
(NPK)P1KN	2.08	2.13	4.21
MEAN	1.68	1.99	3.67
MEAN DM%	35.6	32.8	34.2

PLOT AREA HARVESTED 0.00095

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W.WHEAT AFTER W.WHEAT

GRAIN TONNES/HECTARE

***** TABLES OF MEANS *****

N(NC) MANURE	120	160	200	240	MEAN
(D)P2	10.63	10.77	10.76	11.92	11.02
B	7.99	9.24	9.22	8.62	8.77
(N)P2	7.27	9.19	9.46	8.16	8.52
(P)P1	9.50	9.20	8.14	10.01	9.21
(K)P2K	9.96	10.63	11.06	10.67	10.58
(-)P2	9.99	9.63	8.66	10.03	9.58
(PK)P1K	10.74	11.09	10.69	10.90	10.86
(NK)P2K	11.47	10.28	11.17	11.76	11.17
(NP)P1	9.44	10.06	10.73	10.74	10.24
(NPK)P1K	11.22	10.82	11.06	11.41	11.13
MEAN	9.82	10.09	10.10	10.42	10.11

MEAN DM% 86.3

PLOT AREA HARVESTED 0.00075

W.WHEAT AFTER W.BEANS

GRAIN TONNES/HECTARE

***** TABLES OF MEANS *****

N(NC) MANURE	120	160	200	240	MEAN
(D)P2	9.21	11.98	12.17	10.76	11.03
B	8.30	10.78	10.31	8.74	9.53
(N)P2	10.12	7.50	8.03	10.66	9.08
(P)P1	10.60	8.05	8.70	11.60	9.74
(K)P2K	9.98	11.60	11.76	10.14	10.87
(-)P2	9.93	11.73	11.03	9.34	10.51
(PK)P1K	11.17	12.29	11.92	11.49	11.72
(NK)P2K	12.00	11.47	11.01	12.41	11.72
(NP)P1	9.88	11.52	10.62	11.36	10.84
(NPK)P1K	11.49	11.87	11.87	12.29	11.88
MEAN	10.27	10.88	10.74	10.88	10.69

MEAN DM% 86.2

PLOT AREA HARVESTED 0.00075

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W.WHEAT AFTER W.BEANS

GRAIN TONNES/HECTARE

***** TABLES OF MEANS *****

N(PU) MANURE	0	160	200	MEAN
(D)P2	9.64	11.85	10.79	10.48
B	7.42	8.64	10.15	8.41
(N)P2	7.25	7.52	10.50	8.13
(P)P1	7.71	10.08	8.99	8.63
(K)P2K	7.49	9.96	11.13	9.02
(-)P2	7.74	10.51	9.85	8.96
(PK)P1K	7.90	11.52	10.64	9.49
(NK)P2K	8.50	11.74	11.17	9.98
(NP)P1	8.35	9.72	10.63	9.26
(NPK)P1K	7.95	10.88	10.77	9.39
MEAN	8.00	10.24	10.46	9.17

MEAN DM% 85.2

PLOT AREA HARVESTED 0.00075

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84/S/RN/1-2

W.WHEAT

GRAIN TONNES/HECTARE

***** TABLES OF MEANS *****

K	0	440	MEAN
MANURE			
(D)P2	10.48	9.80	10.14
B	8.29	8.44	8.36
(N)P2	8.80	8.38	8.59
(P)P1	8.04	8.47	8.26
(K)P2K	9.79	8.93	9.36
(-)P2	8.72	8.91	8.82
(PK)P1K	9.21	8.84	9.03
(NK)P2K	9.08	10.12	9.60
(NP)P1	8.90	8.90	8.90
(NPK)P1K	8.94	9.52	9.23
MEAN	9.03	9.03	9.03

N	40+120	40+160	MEAN
MANURE			
(D)P2	9.96	10.32	10.14
B	8.22	8.50	8.36
(N)P2	8.78	8.41	8.59
(P)P1	7.64	8.88	8.26
(K)P2K	9.22	9.50	9.36
(-)P2	8.86	8.77	8.82
(PK)P1K	9.01	9.04	9.03
(NK)P2K	9.68	9.52	9.60
(NP)P1	8.43	9.37	8.90
(NPK)P1K	9.37	9.08	9.23
MEAN	8.92	9.14	9.03

N	40+120	40+160	MEAN
K			
0	8.89	9.16	9.03
440	8.94	9.12	9.03
MEAN	8.92	9.14	9.03

K	0		440	
N	40+120	40+160	40+120	40+160
MANURE				
(D)P2	9.99	10.96	9.93	9.67
B	8.36	8.21	8.08	8.79
(N)P2	8.76	8.85	8.80	7.97
(P)P1	7.28	8.80	8.00	8.95
(K)P2K	10.03	9.54	8.40	9.45
(-)P2	9.24	8.20	8.47	9.34
(PK)P1K	7.81	10.62	10.21	7.47
(NK)P2K	9.88	8.28	9.49	10.75
(NP)P1	8.80	9.00	8.06	9.74
(NPK)P1K	8.75	9.12	10.00	9.04

GRAIN MEAN DM% 84.1 PLOT AREA HARVESTED 0.00075

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S.BARLEY

GRAIN TONNES/HECTARE

***** TABLES OF MEANS *****

TREATMNT MANURE	CNVNTIAL	SUBDUG	SUBDUG+F	MEAN
(D)P2	4.44	4.71	4.95	4.70
B	3.61	4.46	4.15	4.08
(N)P2	3.90	3.71	4.06	3.89
(P)P1	3.74	3.08	3.44	3.42
(K)P2K	4.42	4.23	4.04	4.23
(-)P2	4.17	3.64	3.81	3.88
(PK)P1K	3.88	3.53	3.71	3.71
(NK)P2K	4.04	4.04	4.19	4.09
(NP)P1	3.18	3.86	3.86	3.63
(NPK)P1K	3.66	3.85	3.67	3.73
MEAN	3.91	3.91	3.99	3.93

N MANURE	30+30	30+60	30+90	30+120	MEAN
(D)P2	3.96	4.43	5.26	5.14	4.70
B	3.38	3.91	4.13	4.89	4.08
(N)P2	3.29	3.61	3.91	4.75	3.89
(P)P1	2.37	3.20	4.12	3.98	3.42
(K)P2K	3.31	4.24	4.21	5.17	4.23
(-)P2	2.93	3.18	4.43	4.96	3.88
(PK)P1K	2.59	3.52	4.28	4.45	3.71
(NK)P2K	2.61	4.39	4.18	5.20	4.09
(NP)P1	2.71	3.74	3.86	4.23	3.63
(NPK)P1K	3.69	2.34	3.93	4.94	3.73
MEAN	3.08	3.66	4.23	4.77	3.93

N TREATMNT	30+30	30+60	30+90	30+120	MEAN
CNVNTIAL	3.17	3.75	4.06	4.64	3.91
SUBDUG	3.00	3.71	4.18	4.76	3.91
SUBDUG+F	3.08	3.51	4.45	4.91	3.99
MEAN	3.08	3.66	4.23	4.77	3.93

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84/S/RN/1-3

S.BARLEY

GRAIN TONNES/HECTARE

***** TABLES OF MEANS *****

MANURE	N TREATMNT	30+30	30+60	30+90	30+120
(D)P2	CNVNTIAL	3.59	4.25	4.99	4.92
	SUBDUG	4.43	4.72	5.04	4.65
	SUBDUG+F	3.86	4.32	5.76	5.85
B	CNVNTIAL	2.91	3.21	4.00	4.33
	SUBDUG	3.82	4.38	4.53	5.12
	SUBDUG+F	3.42	4.13	3.85	5.22
(N)P2	CNVNTIAL	3.74	3.61	3.54	4.72
	SUBDUG	3.11	3.08	3.79	4.83
	SUBDUG+F	3.03	4.13	4.39	4.69
(P)P1	CNVNTIAL	2.90	3.38	4.30	4.36
	SUBDUG	2.65	3.46	3.24	2.98
	SUBDUG+F	1.55	2.76	4.83	4.60
(K)P2K	CNVNTIAL	3.14	4.78	4.35	5.43
	SUBDUG	3.14	4.52	4.04	5.24
	SUBDUG+F	3.64	3.43	4.24	4.85
(-)P2	CNVNTIAL	3.50	4.30	4.02	4.88
	SUBDUG	1.84	3.02	4.63	5.06
	SUBDUG+F	3.45	2.23	4.63	4.94
(PK)P1K	CNVNTIAL	3.12	3.82	3.91	4.68
	SUBDUG	1.97	3.20	4.29	4.65
	SUBDUG+F	2.67	3.53	4.63	4.01
(NK)P2K	CNVNTIAL	2.66	4.51	4.42	4.57
	SUBDUG	2.41	4.22	4.49	5.05
	SUBDUG+F	2.75	4.42	3.64	5.97
(NP)P1	CNVNTIAL	2.37	2.98	3.58	3.80
	SUBDUG	2.69	3.70	4.18	4.86
	SUBDUG+F	3.07	4.52	3.81	4.02
(NPK)P1K	CNVNTIAL	3.75	2.66	3.52	4.72
	SUBDUG	3.97	2.74	3.56	5.14
	SUBDUG+F	3.36	1.63	4.72	4.97

GRAIN MEAN DM% 86.9

PLOT AREA HARVESTED 0.00075

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