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78/R/CS/10 and 79/W/CS/10 Long-term Liming - Barley

Rothamsted Research

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78/R/CS/10 and 78/W/CS/10

LONG TERM LIMING

Object: To study the effects of different amounts of lime on the yields of a sequence of crops. The effects of P, K and Mg are also studied - Rothamsted (R) Sawyers I and Woburn (W) Stackyard C.

Sponsor: J. Bolton.

The 17th year, spring barley.

For previous years see 'Details' 1967, 1973 and 74-77/R&W/CS/10.

Design: 2 randomised blocks of 16 plots, split into 2.

Whole plot dimensions: 6.40 x 18.3.

Treatments: All combinations of:-

Whole plots

1. LIME Ground chalk (tonnes CaCO₃) (total applied 1962-63):

R	W
0	0
5	5
10	12
20	19

2. P205 Phosphate, applied cumulatively to previous dressings, as superphosphate (kg P205):

0
63

3. K20 Potassium, applied cumulatively to previous dressings, as muriate of potash (kg K20):

0
126

Sub plots

4. MG Magnesium, applied cumulatively in 1974, 1976 and 1977 as Epsom salts and in 1978 as kieserite (kg Mg):

0
112

Basal applications:

Sawyers I (R): Manures: N at 80 kg, combine drilled. Weedkillers: Dicamba with mecoprop and MCPA ('Banlene Plus' at 4.9 l in 220 l).

Stackyard C (W): Manures: N at 130 kg, combine drilled. Weedkillers: Paraquat at 0.56 kg ion in 220 l. Mecoprop, bromoxynil and ioxynil ('Brittox' at 2.5 kg in 280 l). Fungicide: Tridemorph at 0.53 kg in 280 l.

NOTE: Paraquat was applied on Stackyard C (W) as a spot treatment to control areas of couch grass (*Agropyron repens*).

78/R/CS/10 and 78/W/CS/10

Seed: Sawyers I (R) and Stackyard C (W): Porthos, dressed with ethirimol, sown at 160 kg.

Cultivations, etc.:-

Sawyers I (R): Ploughed: 29 Nov, 1977. Spring-tine cultivated: 7 Apr, 1978.

Treatment P, K and Mg applied, power harrowed, seed sown: 19 Apr.

Weedkiller applied: 8 June. Combine harvested: 8 Sept.

Stackyard C (W): Paraquat applied: 23 Sept, 1977. Ploughed: 30 Sept.

Spring-tine cultivated: 9 Mar. P, K and Mg applied, spring-tine

cultivated with crumbler attached: 13 Mar. Seed sown: 15 Mar. Spring-

tine cultivated with crumbler attached, seed resown because of bird

damage: 3 Apr. Weedkiller and fungicide applied: 15 May. Combine

harvested: 23 Aug.

NOTES: (1) At both Rothamsted and Woburn measurable yields were obtained from treatment LIME 0 only in combinations with P205 63 and K20 126 (one replicate at Rothamsted, two replicates at Woburn). Grain yields, tonnes/hectare from these combinations were:

	Rothamsted	Woburn
LIME 0 P205 63 K20 126 MG 0	1.51	1.05
LIME 0 P205 63 K20 126 MG 112	1.59	2.13

These figures have been excluded from the main analysis.

(2) At Rothamsted only, no measurable yields were obtained from one of the replicates of certain combinations of LIME 5 with the other treatments. Combinations affected were all those of P205 0 with K20 0 and 126 and MG 0 and 112 and also the single combination P205 63, K20 0, MG 0. Yields from the remainder are presented in the four-way tables but have been excluded from the analysis.

78/R/CS/10 SAWYERS I(R)

GRAIN TONNES/HECTARE

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

P205	0	63	MEAN
LIME			
10	3.50	4.52	4.01
20	3.55	4.84	4.20
MEAN	3.52	4.68	4.10
K20	0	126	MEAN
LIME			
10	3.60	4.42	4.01
20	3.90	4.49	4.20
MEAN	3.75	4.45	4.10
K20	0	126	MEAN
P205			
0	3.10	3.94	3.52
63	4.40	4.96	4.68
MEAN	3.75	4.45	4.10

78/R/CS/10 SAWYERS I(R)

GRAIN TONNES/HECTARE

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

MG	0	112	MEAN	
LIME				
10	3.89	4.13	4.01	
20	4.18	4.21	4.20	
MEAN	4.03	4.17	4.10	
MG	0	112	MEAN	
P205				
0	3.39	3.65	3.52	
63	4.67	4.69	4.68	
MEAN	4.03	4.17	4.10	
MG	0	112	MEAN	
K20				
0	3.62	3.88	3.75	
126	4.44	4.46	4.45	
MEAN	4.03	4.17	4.10	
P205	0		63	
K20	0	126	0	126
LIME				
10	3.11	3.88	4.08	4.95
20	3.09	4.01	4.72	4.97
P205	0		63	
MG	0	112	0	112
LIME				
10	3.27	3.73	4.51	4.52
20	3.52	3.58	4.84	4.85
K20	0		126	
MG	0	112	0	112
LIME				
10	3.32	3.87	4.45	4.38
20	3.92	3.89	4.44	4.54
K20	0		126	
MG	0	112	0	112
P205				
0	2.87	3.33	3.91	3.98
63	4.37	4.43	4.98	4.94

78/R/CS/10 SAWYERS I(R)

GRAIN TONNES/HECTARE

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

	K20	0	126	
	MG	0	112	0
LIME	P205			112
5	0	1.34	1.73	0.78
5	63	1.70	2.42	4.51
10	0	2.73	3.50	3.80
10	63	3.92	4.24	5.10
20	0	3.02	3.16	4.02
20	63	4.82	4.62	4.86

***** STANDARD ERRORS OF DIFFERENCES OF MEANS *****

TABLE	LIME	P205	K20	MG
SED	0.303	0.303	0.303	0.121
TABLE	LIME	LIME	P205	LIME
	P205	K20	K20	MG
SED	0.428	0.428	0.428	0.326
EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF:				
LIME				0.171
TABLE	P205	K20	LIME	LIME
	MG	MG	P205	P205
			K20	MG
SED	0.326	0.326	0.605	0.461
EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF:				
P205	0.171			
K20		0.171		
LIME.P205				0.243
TABLE	LIME	P205	LIME*	
	K20	K20	P205	
	MG	MG	K20	
			MG	
SED	0.461	0.461	0.652	
EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF:				
LIME.K20	0.243			
P205.K20		0.243		
LIME.P205.K20			0.343	

* DO NOT USE FOR COMPARISONS INVOLVING LIME 5

***** STRATUM STANDARD ERRORS AND COEFFICIENTS OF VARIATION *****

STRATUM	DF	SE	CV%
BLOCK.WP	7	0.605	14.8
BLOCK.WP.SP	8	0.343	8.4

GRAIN MEAN DM% 75.0

78/R/CS/10 SAWYERS I(R)

STRAW TONNES/HECTARE

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

P205	0	63	MEAN
LIME			
10	1.92	2.33	2.12
20	2.08	2.57	2.32
MEAN	2.00	2.45	2.22
K20	0	126	MEAN
LIME			
10	1.78	2.47	2.12
20	2.13	2.51	2.32
MEAN	1.96	2.49	2.22
K20	0	126	MEAN
P205			
0	1.64	2.35	2.00
63	2.27	2.63	2.45
MEAN	1.96	2.49	2.22
MG	0	112	MEAN
LIME			
10	2.08	2.16	2.12
20	2.32	2.32	2.32
MEAN	2.20	2.24	2.22
MG	0	112	MEAN
P205			
0	1.97	2.03	2.00
63	2.44	2.46	2.45
MEAN	2.20	2.24	2.22
MG	0	112	MEAN
K20			
0	1.87	2.05	1.96
126	2.54	2.44	2.49
MEAN	2.20	2.24	2.22

78/R/CS/10 SAWYERS I(R)

STRAW TONNES/HECTARE

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

P205	0		63		
K20	0	126	0	126	
LIME					
10	1.56	2.27	2.00	2.66	
20	1.73	2.42	2.54	2.61	
P205	0		63		
MG	0	112	0	112	
LIME					
10	1.84	2.00	2.33	2.33	
20	2.10	2.05	2.55	2.59	
K20	0		126		
MG	0	112	0	112	
LIME					
10	1.56	2.00	2.60	2.33	
20	2.17	2.10	2.48	2.55	
K20	0		126		
MG	0	112	0	112	
P205					
0	1.56	1.73	2.37	2.32	
63	2.17	2.37	2.71	2.55	
	K20	0		126	
	MG	0	112	0	112
LIME	P205				
5	0	0.65	0.97	0.42	0.74
5	63	0.76	1.18	2.50	2.40
10	0	1.28	1.83	2.39	2.16
10	63	1.85	2.16	2.82	2.49
20	0	1.84	1.62	2.36	2.49
20	63	2.50	2.57	2.61	2.61

STRAW MEAN DM% 90.7

PLOT AREA HARVESTED 0.00247

78/W/CS/10 STACKYARD C(W)

GRAIN TONNES/HECTARE

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

P205	0	63	MEAN
LIME			
5	4.05	4.40	4.22
12	4.79	4.85	4.82
19	4.99	5.07	5.03
MEAN	4.61	4.77	4.69
K20	0	126	MEAN
LIME			
5	4.14	4.30	4.22
12	4.55	5.10	4.82
19	4.61	5.45	5.03
MEAN	4.43	4.95	4.69
K20	0	126	MEAN
P205			
0	4.40	4.83	4.61
63	4.47	5.07	4.77
MEAN	4.44	4.95	4.69
MG	0	112	MEAN
LIME			
5	3.87	4.57	4.22
12	4.73	4.92	4.82
19	4.93	5.13	5.03
MEAN	4.51	4.87	4.69
MG	0	112	MEAN
P205			
0	4.40	4.82	4.61
63	4.62	4.93	4.77
MEAN	4.51	4.87	4.69
MG	0	112	MEAN
K20			
0	4.21	4.66	4.44
126	4.82	5.08	4.95
MEAN	4.51	4.87	4.69

78/W/CS/10 STACKYARD C(W)

GRAIN TONNES/HECTARE

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

P205	0		63		
K20	0	126	0	126	
LIME					
5	4.12	3.97	4.16	4.63	
12	4.51	5.07	4.59	5.12	
19	4.55	5.43	4.68	5.47	
P205	0		63		
MG	0	112	0	112	
LIME					
5	3.58	4.52	4.16	4.63	
12	4.68	4.90	4.77	4.93	
19	4.94	5.04	4.93	5.22	
K20	0		126		
MG	0	112	0	112	
LIME					
5	3.80	4.48	3.94	4.67	
12	4.42	4.68	5.04	5.15	
19	4.40	4.83	5.47	5.43	
K20	0		126		
MG	0	112	0	112	
P205					
0	4.17	4.62	4.64	5.02	
63	4.25	4.70	4.99	5.15	
	K20	0		126	
	MG	0	112	0	112
LIME	P205				
5	0	3.74	4.50	3.42	4.53
5	63	3.86	4.46	4.46	4.81
12	0	4.39	4.63	4.97	5.17
12	63	4.44	4.73	5.11	5.13
19	0	4.36	4.74	5.52	5.35
19	63	4.43	4.92	5.42	5.52

78/W/CS/10 STACKYARD C(W)

GRAIN TONNES/HECTARE

***** STANDARD ERRORS OF DIFFERENCES OF MEANS *****

TABLE	LIME	P205	K20	MG
SED	0.190	0.155	0.155	0.113
TABLE	LIME P205	LIME K20	P205 K20	LIME MG
SED	0.269	0.269	0.220	0.235
EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF: LIME				0.196
TABLE	P205 MG	K20 MG	LIME P205 K20	LIME P205 MG
SED	0.192	0.192	0.381	0.333
EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF: P205	0.160			
K20		0.160		
LIME.P205				0.277
TABLE	LIME K20 MG	P205 K20 MG	LIME P205 K20 MG	
SED	0.333	0.272	0.471	
EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF: LIME.K20	0.277			
P205.K20		0.226		
LIME.P205.K20			0.392	

***** STRATUM STANDARD ERRORS AND COEFFICIENTS OF VARIATION *****

STRATUM	DF	SE	CV%
BLOCK.WP	11	0.381	8.1
BLOCK.WP.SP	12	0.392	8.3

GRAIN MEAN DM% 77.4

78/W/CS/10 STACKYARD C(W)

STRAW TONNES/HECTARE

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

P205	0	63	MEAN
LIME			
5	2.20	2.29	2.25
12	2.63	2.67	2.65
19	2.88	2.77	2.82

MEAN	2.57	2.58	2.57
------	------	------	------

K20	0	126	MEAN
LIME			
5	2.03	2.46	2.25
12	2.45	2.85	2.65
19	2.34	3.31	2.82

MEAN	2.27	2.88	2.57
------	------	------	------

K20	0	126	MEAN
P205			
0	2.19	2.94	2.57
63	2.35	2.81	2.58

MEAN	2.27	2.88	2.57
------	------	------	------

MG	0	112	MEAN
LIME			
5	2.02	2.47	2.25
12	2.64	2.66	2.65
19	2.76	2.89	2.82

MEAN	2.47	2.67	2.57
------	------	------	------

MG	0	112	MEAN
P205			
0	2.41	2.73	2.57
63	2.54	2.62	2.58

MEAN	2.47	2.67	2.57
------	------	------	------

MG	0	112	MEAN
K20			
0	2.08	2.46	2.27
126	2.87	2.88	2.88

MEAN	2.47	2.67	2.57
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78/W/CS/10 STACKYARD C(W)

STRAW TONNES/HECTARE

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

P205	0		63		
K20	0	126	0	126	
LIME					
5	1.98	2.42	2.08	2.51	
12	2.37	2.88	2.52	2.82	
19	2.23	3.53	2.44	3.09	
P205	0		63		
MG	0	112	0	112	
LIME					
5	1.88	2.51	2.17	2.42	
12	2.58	2.67	2.69	2.65	
19	2.77	3.00	2.76	2.78	
K20	0		126		
MG	0	112	0	112	
LIME					
5	1.77	2.28	2.27	2.66	
12	2.37	2.53	2.90	2.80	
19	2.10	2.58	3.43	3.20	
K20	0		126		
MG	0	112	0	112	
P205					
0	1.89	2.50	2.93	2.96	
63	2.27	2.43	2.81	2.81	
	K20	0	126		
	MG	0	112	0	112
LIME	P205				
5	0	1.56	2.40	2.21	2.63
5	63	1.99	2.17	2.34	2.68
12	0	2.25	2.49	2.91	2.86
12	63	2.49	2.56	2.90	2.75
19	0	1.86	2.60	3.67	3.39
19	63	2.33	2.56	3.19	3.00

STRAW MEAN DM% 78.2

SUB PLOT AREA HARVESTED 0.00247