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76/R/G/1 and 76/W/G/1 Aqueous Ammonia and Nitrification Inhibitors - Grass

Rothamsted Research

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76/R/G/1 and 76/W/G/1

GRASS

AQUEOUS AMMONIA AND NITRIFICATION INHIBITORS

Object: To study the effects of adding a range of nitrification inhibitors to aqueous ammonia on the yield and nitrogen uptake of grass cut for-silage. Rothamsted (R) Bones Close and Woburn (W) Lower Field.

Sponsors: J. Ashworth, G.G. Briggs, A. Penny.

Design: 2 randomised blocks of 24 plots.

Whole plot dimensions: 2.43 x 9.14.

Treatments: All combinations of:-

1. NI INHIB Nitrification inhibitors added to aqueous ammonia applied at 375 kg N, as a single application, injection tines spaced 30 cm apart:

CS2	Carbon disulphide
NITRAPYR	Nitrapyrin ('N-Serve')

2. NI RATE Rates of nitrification inhibitors:

1	1 (5 kg (R), 2 kg (W) carbon disulphide; 0.5 kg (R) and (W) nitrapyrin)
2	2 (12.5 kg (R), 7 kg (W) carbon disulphide; 1.25 kg (R) and (W) nitrapyrin)
3	3 (25 kg (R), 20 kg (W) carbon disulphide; 2.5 kg (R) and (W) nitrapyrin)

3. NI TIME Times of applying aqueous ammonia and nitrification inhibitors:

AUTUMN	Autumn
SPRING	Spring

plus twelve extra treatments:

EXTRA Aqueous ammonia applied as above:-

AQ/A	Alone, in autumn
AQ/S	Alone, in spring
AQ+CN1/A	With a mixture of carbon disulphide (12.5 kg (R) and (W)) and nitrapyrin (0.5 kg (R) and (W)) in autumn
AQ+CN2/A	With a mixture of carbon disulphide (12.5 kg (R) and (W)) and nitrapyrin (1.25 kg (R) and (W)) in autumn
AQ+AT1/S	With ammonium trithiocarbonate (4 kg (R) and (W)) in spring
AQ+AT2/S	With ammonium trithiocarbonate (10 kg (R) and (W)) in spring
AQ+AT3/S	With ammonium trithiocarbonate (20 kg (R) and (W)) in spring
AQ+ST/A	With sodium trithiocarbonate (25 kg (R) and (W)) in autumn

'Nitro-Chalk', dressing divided between cuts (kg N, total):-

0	None
NC 250	250
NC 375	375
NC 500	500

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Basal applications:

Bones Close (R): Manures: (0:14:28) at 500 kg. Weedkiller: Mecoprop at 2.7 kg in 220 l.

Lower Field (W): Manures: (0:14:28) at 500 kg.

Cultivations, etc.:-

Bones Close (R): Aqueous ammonia autumn treatments injected: 14 Nov, 1975.

PK applied: 3 Dec. Aqueous ammonia spring treatments injected:

24 Feb, 1976. 'Nitro-Chalk' applied in three equal applications:

8 Mar, 26 May, 13 Aug. Weedkiller applied: 19 Mar. Cut three times:

24 May, 9 Aug, 26 Oct. Previous crops: Grass since 1952.

Lower Field (W): Aqueous ammonia autumn treatments injected: 17 Nov, 1975.

PK applied: 18 Nov. Aqueous ammonia spring treatments injected:

25 Feb, 1976. 'Nitro-Chalk' applied in three equal applications:

9 Mar, 18 June, 20 Aug. Cut once: 9 June. Previous crops: Permanent grass.

NOTES: (1) Grass samples were taken for N determinations.

(2) N in the injected soil profile was measured at regular intervals from November, 1975 to June, 1976 and ammonia evaporation measured.

76/R/G/1 BONES CLOSE (R)

1ST CUT (24/5/76) DRY MATTER TONNES/HECTARE

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

NI RATE	1	2	3	MEAN
NI INHIB				
CS2	5.01	5.25	5.00	5.09
NITRAPYR	5.07	5.22	5.18	5.15
MEAN	5.04	5.23	5.09	5.12

NI RATE	1	2	3	MEAN
NI TIME				
AUTUMN	5.48	5.49	5.59	5.52
SPRING	4.60	4.98	4.59	4.72
MEAN	5.04	5.23	5.09	5.12

NI TIME	AUTUMN	SPRING	MEAN
NI INHIB			
CS2	5.51	4.66	5.09
NITRAPYR	5.53	4.78	5.15
MEAN	5.52	4.72	5.12

NI INHIB	NI RATE	1	2	3
CS2	AUTUMN	5.68	5.36	5.49
	SPRING	4.34	5.13	4.52
NITRAPYR	AUTUMN	5.28	5.61	5.69
	SPRING	4.86	4.82	4.67

EXTRA	
AQ/A	5.82
AQ/S	4.82
AQ+CN1/A	5.91
AQ+CN2/A	5.58
AQ+AT1/S	4.64
AQ+AT2/S	4.85
AT+AT3/S	5.29
AQ+ST/A	5.42
0	2.60
NC 250	4.27
NC 375	4.63
NC 500	5.65
MEAN	4.96

GRAND MEAN 5.04

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

TABLE	EXTRA	NI INHIB	NI RATE	NI TIME
SED	0.348	0.142	0.174	0.142

TABLE	NI INHIB	NI INHIB	NI RATE	NI INHIB
	NI RATE	NI TIME	NI TIME	NI RATE
				NI TIME
SED	0.246	0.201	0.246	0.348

76/R/G/1 BONES CLOSE (R)

2ND CUT (9/8/76) DRY MATTER TONNES/HECTARE

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

NI RATE	1	2	3	MEAN
NI INHIB				
CS2	0.64	0.73	0.64	0.67
NITRAPYR	0.81	0.72	0.56	0.70
MEAN	0.73	0.73	0.60	0.68

NI RATE	1	2	3	MEAN
NI TIME				
AUTUMN	0.77	0.71	0.58	0.68
SPRING	0.69	0.75	0.62	0.69
MEAN	0.73	0.73	0.60	0.68

NI TIME	AUTUMN	SPRING	MEAN
NI INHIB			
CS2	0.71	0.64	0.67
NITRAPYR	0.66	0.74	0.70
MEAN	0.68	0.69	0.68

NI INHIB	NI RATE	1	2	3
CS2	AUTUMN	0.75	0.75	0.62
	SPRING	0.54	0.72	0.66
NITRAPYR	AUTUMN	0.79	0.66	0.53
	SPRING	0.84	0.78	0.59

EXTRA	
AQ/A	0.66
AQ/S	0.70
AQ+CN1/A	0.76
AQ+CN2/A	0.93
AQ+AT1/S	0.86
AQ+AT2/S	0.65
AT+AT3/S	0.93
AQ+ST/A	0.86
0	0.46
NC 250	0.78
NC 375	0.67
NC 500	0.89
MEAN	0.76

GRAND MEAN 0.72

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

TABLE	EXTRA	NI INHIB	NI RATE	NI TIME
SED	0.200	0.082	0.100	0.082

TABLE	NI INHIB	NI INHIB	NI RATE	NI INHIB
	NI RATE	NI TIME	NI TIME	NI RATE
				NI TIME
SED	0.142	0.116	0.142	0.200

76/R/G/1 BONES CLOSE (R)

3RD CUT (26/10/76) DRY MATTER TONNES/HECTARE

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

	1	2	3	MEAN
NI RATE				
NI INHIB				
CS2	1.34	1.44	1.26	1.34
NITRAPYR	1.46	1.29	1.32	1.36
MEAN	1.40	1.37	1.29	1.35

	1	2	3	MEAN
NI RATE				
NI TIME				
AUTUMN	1.28	1.11	1.20	1.20
SPRING	1.52	1.62	1.37	1.50
MEAN	1.40	1.37	1.29	1.35

	AUTUMN	SPRING	MEAN
NI TIME			
NI INHIB			
CS2	1.11	1.57	1.34
NITRAPYR	1.28	1.43	1.36
MEAN	1.20	1.50	1.35

	NI RATE	1	2	3
NI INHIB	NI TIME			
CS2	AUTUMN	1.08	1.13	1.13
	SPRING	1.60	1.75	1.38
NITRAPYR	AUTUMN	1.48	1.10	1.26
	SPRING	1.44	1.49	1.37

EXTRA	
AQ/A	1.15
AQ/S	1.58
AQ+CN1/A	1.21
AQ+CN2/A	1.53
AQ+AT1/S	1.44
AQ+AT2/S	1.66
AT+AT3/S	1.78
AQ+ST/A	1.72
0	0.80
NC 250	1.66
NC 375	1.76
NC 500	1.58
MEAN	1.49

GRAND MEAN 1.42

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

TABLE	EXTRA	NI INHIB	NI RATE	NI TIME
SED	0.229	0.093	0.114	0.093

TABLE	NI INHIB NI RATE	NI INHIB NI TIME	NI RATE NI TIME	NI INHIB NI RATE NI TIME
SED	0.162	0.132	0.162	0.229

76/R/G/1 BONES CLOSE (R)

TOTAL OF 3 CUTS DRY MATTER TONNES/HECTAHE

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

NI RATE	1	2	3	MEAN
NI INHIB				
CS2	6.99	7.42	6.90	7.10
NITRAPYR	7.35	7.23	7.05	7.21
MEAN	7.17	7.32	6.98	7.16

NI RATE	1	2	3	MEAN
NI TIME				
AUTUMN	7.53	7.31	7.36	7.40
SPRING	6.81	7.34	6.59	6.91
MEAN	7.17	7.32	6.98	7.16

NI TIME	AUTUMN	SPRING	MEAN
NI INHIB			
CS2	7.33	6.87	7.10
NITRAPYR	7.47	6.95	7.21
MEAN	7.40	6.91	7.16

NI INHIB	NI RATE	1	2	3
CS2	AUTUMN	7.51	7.24	7.25
	SPRING	6.47	7.60	6.56
NITRAPYR	AUTUMN	7.56	7.37	7.48
	SPRING	7.14	7.09	6.62

EXTRA	
AQ/A	7.63
AQ/S	7.11
AQ+CN1/A	7.87
AQ+CN2/A	8.03
AQ+AT1/S	6.94
AQ+AT2/S	7.16
AT+AT3/S	7.99
AQ+ST/A	8.00
0	3.86
NC 250	6.72
NC 375	7.07
NC 500	8.12
MEAN	7.21
GRAND MEAN	7.18

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

TABLE	EXTRA	NI INHIB	NI RATE	NI TIME
SED	0.585	0.239	0.292	0.239
TABLE	NI INHIB	NI INHIB	NI RATE	NI INHIB
	NI RATE	NI TIME	NI TIME	NI RATE
				NI TIME
SED	0.413	0.338	0.413	0.585

76/W/G/1 LOWER FIELD (W)

1ST AND ONLY CUT (9/6/76) DRY MATTER TONNES/HECTARE

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

NI RATE	1	2	3	MEAN
NI INHIB				
CS2	5.11	4.96	4.24	4.77
NITRAPYR	5.95	4.69	5.19	5.28
MEAN	5.53	4.83	4.71	5.02

NI RATE	1	2	3	MEAN
NI TIME				
AUTUMN	5.30	4.78	4.93	5.00
SPRING	5.76	4.87	4.50	5.05
MEAN	5.53	4.83	4.71	5.02

NI TIME	AUTUMN	SPRING	MEAN
NI INHIB			
CS2	5.00	4.54	4.77
NITRAPYR	5.00	5.55	5.28
MEAN	5.00	5.05	5.02

	NI RATE	1	2	3
NI INHIB	NI TIME			
CS2	AUTUMN	5.13	5.25	4.62
	SPRING	5.09	4.67	3.87
NITRAPYR	AUTUMN	5.47	4.31	5.24
	SPRING	6.43	5.08	5.13

EXTRA	
AQ/A	5.18
AQ/S	4.67
AQ+CN1/A	3.49
AQ+CN2/A	5.17
AQ+AT1/S	5.55
AQ+AT2/S	6.24
AT+AT3/S	3.81
AQ+ST/A	5.22
0	4.36
NC 250	3.45
NC 375	4.93
NC 500	5.48
MEAN	4.80

GRAND MEAN 4.91

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

TABLE	EXTRA	NI INHIB	NI RATE	NI TIME
SED	0.967	0.395	0.484	0.395
TABLE	NI INHIB	NI INHIB	NI RATE	NI INHIB
	NI RATE	NI TIME	NI TIME	NI RATE
				NI TIME
SED	0.684	0.559	0.684	0.967

76/R/G/1 BONES CLOSE (R)

1ST CUT (24/5/76) DRY MATTER TONNES/HECTARE

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

STRATUM	DF	SE	CV%
BLOCK.WP	23	0.348	6.9

1ST CUT MEAN DM% 24.5

2ND CUT (9/8/76) DRY MATTER TONNES/HECTARE

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

STRATUM	DF	SE	CV%
BLOCK.WP	23	0.200	27.7

2ND CUT MEAN DM% 43.2

3RD CUT (26/10/76) DRY MATTER TONNES/HECTARE

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

STRATUM	DF	SE	CV%
BLOCK.WP	23	0.229	16.1

3RD CUT MEAN DM% 13.5

TOTAL OF 3 CUTS DRY MATTER TONNES/HECTARE

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

STRATUM	DF	SE	CV%
BLOCK.WP	23	0.585	8.1

TOTAL OF 3 CUTS MEAN DM% 27.1

PLOT AREA HARVESTED 0.00104

76/W/G/1 LOWER FIELD (W)

1ST AND ONLY CUT (9/6/76) DRY MATTER TONNES/HECTARE

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

STRATUM	DF	SE	CV%
BLOCK.WP	23	0.967	19.7

MEAN DM% 39.3

PLOT AREA HARVESTED 0.00078