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78/R/WW/2 and 78/W/WW/2 Aqueous N and Nitrification Inhibitors - W. Wheat

Rothamsted Research

Rothamsted Research (1979) *78/R/WW/2 and 78/W/WW/2 Aqueous N and Nitrification Inhibitors - W. Wheat* ; Yields Of The Field Experiments 1978, pp 339 - 347 - DOI:

<https://doi.org/10.23637/ERADOC-1-30>

78/R/WW/2 and 78/W/WW/2

WINTER WHEAT

AQUEOUS N AND NITRIFICATION INHIBITORS

Object: To study the effects of adding nitrification inhibitors to aqueous urea and aqueous ammonia on the yield and nitrogen uptake of winter wheat sown conventionally or direct drilled - Rothamsted (R), White Horse I and Woburn (W), Horsepool Lane Close West.

Sponsors: F.V. Widdowson, A. Penny, J. Ashworth.

Design: Single replicate of 40 plots, split semi-systematically into 2 for DRILLING (White Horse I (R)). 2 randomised blocks of 42 plots (Horsepool Lane Close West (W)).

Whole plot dimensions: White Horse I (R): 4.27 x 29.0.
Horsepool Lane Close West (W): 4.27 x 9.14.

Treatments: All combinations of:-

Whole plots

1. N FORM(1) Forms of aqueous nitrogen:

 AMMONIA Aqueous ammonia 28% N
 UREA Aqueous urea 18% N
2. N RATE Rate of nitrogen (kg N):

 80
 120
3. N TIME Times of applying aqueous nitrogen:

 AUTUMN
 SPRING
4. NIT INHB Nitrification inhibitors added to aqueous nitrogen:

 NONE None
 NITRAPYR Nitrapyrin
 SOD TRI Sodium trithiocarbonate

plus extra treatments given additional forms of nitrogen fertiliser (kg N):

N FORM(2)

0	0
NC 70	70 as 'Nitro-Chalk' in spring
NC 80	80 as 'Nitro-Chalk' in spring
NC 90	90 as 'Nitro-Chalk' in spring
NC 100	100 as 'Nitro-Chalk' in spring
NC 110	110 as 'Nitro-Chalk' in spring
NC 120	120 as 'Nitro-Chalk' in spring
NC 130	130 as 'Nitro-Chalk' in spring

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A40INC80	Aqueous ammonia (A) at 40 plus nitrapyrin (I) applied in autumn, 'Nitro-Chalk 25' (NC) at 80 in spring
A80INC40	A at 80 plus I in autumn, NC at 40 in spring
A40TNC80	A at 40 plus sodium trithiocarbonate (T) in autumn, NC at 80 in spring
A80TNC40	A at 80 plus T in autumn, NC at 40 in spring
U40INC80	Aqueous urea (U) at 40 plus I in autumn, NC at 80 in spring
U80INC40	U at 80 plus I in autumn, NC at 40 in spring
U40TNC80	U at 40 plus T in autumn, NC at 80 in spring
U80TNC40	U at 80 plus T in autumn, NC at 40 in spring

and at Horsepool Lane Close West (W) only, in aqueous form in spring:

AS -- 120	120 as ammonium sulphate
AS IC 120	120 as ammonium sulphate plus I and carbon disulphide

Sub plots (White Horse I (R) only)

5. DRILLING Cultivations and drilling:

CNVNTIAL	Cultivated and conventionally drilled
DIRECT	Uncultivated, direct drilled

NOTES: (1) Nitrification inhibitor rates:

White Horse I (R): Aqueous N applied with nitrapyrin at 1.5 kg or with sodium trithiocarbonate at 40 kg in autumn and with nitrapyrin at 1.0 kg or with sodium trithiocarbonate at 17 kg in spring.

Horsepool Lane Close West (W): Aqueous N applied with nitrapyrin at 1.5 kg or with sodium trithiocarbonate at 40 kg in autumn and with nitrapyrin at 1.0 kg or with sodium trithiocarbonate at 20 kg. Aqueous ammonium sulphate applied with nitrapyrin at 1.0 kg plus carbon disulphide at 10 kg as an emulsion in spring.

(2) Aqueous nitrogen was applied by injectors with tines spaced 30 cm apart, 10 cm deep.

Basal applications:

White Horse I (R): Manures: (0:20:20) at 310 kg, combine drilled. Weedkillers: Difenzoquat at 0.99 kg with 1 l 'Agral' (a wetting agent) plus 2, 4-D at 0.98 kg in 220 l. Paraquat at 0.84 kg ion and 0.56 kg ion on successive occasions, both in 220 l. Growth regulator: Chlormequat at 1.4 kg in 220 l. Horsepool Lane Close West (W): Manures: (0:20:20) at 310 kg, combine drilled. Weedkiller: Mecoprop at 2.1 kg in 280 l. Growth regulator: Chlormequat at 1.7 kg in 280 l.

Seed: White Horse I (R) and Horsepool Lane Close West (W): Maris Huntsman, sown at 190 kg.

Cultivations, etc.:-

White Horse I (R): Stubble chopped: 21 Sept, 1977. Conventionally drilled plots only: Heavy spring-tine cultivated three times: 4 Oct. Paraquat applied twice: 11 Oct, 19 Oct. Aqueous N with inhibitors injected: 12 Oct. Conventionally drilled plots only: rotary harrowed 28 Oct, seed sown 29 Oct. Direct drilled plots only: seed sown 4 Nov. Aqueous N with inhibitors injected: 10 Apr, 1978. 'Nitro-Chalk' treatments applied: 27 Apr. Weedkillers applied: 11 May. Growth regulator applied: 17 May. Combine harvested: 29 Aug. Previous crops: Barley 1976, oats 1977.

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Horsepool Lane Close West (W): Heavy spring-tine cultivated twice: 22 Sept, 1977. Aqueous N with inhibitors injected: 10 Oct. Heavy spring-tine cultivated, rotary cultivated: 19 Oct. Seed sown: 20 Oct. Weedkiller applied: 8 Apr, 1978. Aqueous N with inhibitors injected: 17 Apr. 'Nitro-Chalk' treatments applied: 27 Apr. Growth regulator applied: 18 May. Combine harvested: 4 Sept. Previous crops: Barley 1976, winter oats 1977.

- NOTES: (1) Soil samples were taken at monthly intervals, November to July for measurement of N in the injected bands. N was measured in a cross section of the band at Rothamsted only.
(2) Plant top samples were taken at fortnightly intervals from April until G.S.10 and then ear samples for measurement of nitrate N at Rothamsted only.

78/R/WW/2 WHITE HORSE I(R)

GRAIN TONNES/HECTARE

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

N FORM(1)	AMMONIA	UREA	MEAN
NIT INHB			
NONE	5.24	5.37	5.30
NITRAPYR	6.03	5.89	5.96
SOD TRI	5.09	5.99	5.54
MEAN	5.45	5.75	5.60
N RATE	80	120	MEAN
NIT INHB			
NONE	5.06	5.54	5.30
NITRAPYR	5.47	6.45	5.96
SOD TRI	5.06	6.03	5.54
MEAN	5.20	6.01	5.60
N RATE	80	120	MEAN
N FORM(1)			
AMMONIA	5.12	5.79	5.45
UREA	5.27	6.23	5.75
MEAN	5.20	6.01	5.60
N TIME	AUTUMN	SPRING	MEAN
NIT INHB			
NONE	4.17	6.43	5.30
NITRAPYR	5.39	6.54	5.96
SOD TRI	4.79	6.30	5.54
MEAN	4.78	6.42	5.60
N TIME	AUTUMN	SPRING	MEAN
N FORM(1)			
AMMONIA	4.61	6.30	5.45
UREA	4.95	6.55	5.75
MEAN	4.78	6.42	5.60

78/R/WW/2 WHITE HORSE I(R)

GRAIN TONNES/HECTARE

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

N TIME N RATE	AUTUMN	SPRING	MEAN
80	4.29	6.11	5.20
120	5.27	6.74	6.01
MEAN	4.78	6.42	5.60
DRILLING NIT INHB	CNVNTIAL	DIRECT	MEAN
NONE	5.09	5.52	5.30
NITRAPYR	5.86	6.06	5.96
SOD TRI	5.35	5.74	5.54
MEAN	5.43	5.77	5.60
DRILLING N FORM(1)	CNVNTIAL	DIRECT	MEAN
AMMONIA	5.26	5.65	5.45
UREA	5.60	5.90	5.75
MEAN	5.43	5.77	5.60
DRILLING N RATE	CNVNTIAL	DIRECT	MEAN
80	4.97	5.43	5.20
120	5.90	6.12	6.01
MEAN	5.43	5.77	5.60
DRILLING N TIME	CNVNTIAL	DIRECT	MEAN
AUTUMN	4.65	4.91	4.78
SPRING	6.21	6.64	6.42
MEAN	5.43	5.77	5.60
DRILLING N FORM(2)	CNVNTIAL	DIRECT	MEAN
0	4.23	4.86	4.54
NC 70	5.75	5.15	5.45
NC 80	6.03	6.32	6.18
NC 90	6.26	6.22	6.24
NC 100	6.86	7.00	6.93
NC 110	6.88	6.09	6.49
NC 120	6.90	6.86	6.88
NC 130	6.97	6.86	6.92
A40INC80	4.83	6.26	5.55
A80INC40	6.40	6.91	6.66
A40TNC80	6.26	6.69	6.47
A80TNC40	5.51	5.91	5.71
U40INC80	6.45	6.36	6.41
U80INC40	6.01	6.54	6.27
U40TNC80	5.96	6.72	6.34
U80TNC40	6.21	5.94	6.07
MEAN	6.09	6.29	6.19

78/R/WW/2 WHITE HORSE I(R)

GRAIN TONNES/HECTARE

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

N FORM(1)	AMMONIA		UREA	
N RATE	80	120	80	120
NIT INHB				
NONE	5.16	5.31	4.97	5.77
NITRAPYR	5.45	6.62	5.50	6.28
SOD TRI	4.76	5.42	5.35	6.63
N FORM(1)	AMMONIA		UREA	
N TIME	AUTUMN	SPRING	AUTUMN	SPRING
NIT INHB				
NONE	4.28	6.19	4.06	6.68
NITRAPYR	5.32	6.75	5.45	6.33
SOD TRI	4.22	5.97	5.36	6.62
N RATE	80		120	
N TIME	AUTUMN	SPRING	AUTUMN	SPRING
NIT INHB				
NONE	3.95	6.17	4.39	6.70
NITRAPYR	4.59	6.35	6.18	6.73
SOD TRI	4.32	5.80	5.26	6.79
N RATE	80		120	
N TIME	AUTUMN	SPRING	AUTUMN	SPRING
N FORM(1)				
AMMONIA	4.26	5.99	4.96	6.62
UREA	4.32	6.23	5.59	6.86
N FORM(1)	AMMONIA		UREA	
DRILLING CNVTIAL		DIRECT CNVTIAL		DIRECT
NIT INHB				
NONE	5.17	5.30	5.00	5.73
NITRAPYR	5.72	6.34	6.00	5.78
SOD TRI	4.89	5.30	5.81	6.17
N RATE	80		120	
DRILLING CNVTIAL		DIRECT CNVTIAL		DIRECT
NIT INHB				
NONE	4.85	5.27	5.32	5.77
NITRAPYR	5.26	5.69	6.46	6.44
SOD TRI	4.78	5.33	5.91	6.14
N RATE	80		120	
DRILLING CNVTIAL		DIRECT CNVTIAL		DIRECT
N FORM(1)				
AMMONIA	4.79	5.45	5.73	5.85
UREA	5.14	5.41	6.07	6.39
N TIME	AUTUMN		SPRING	
DRILLING CNVTIAL		DIRECT CNVTIAL		DIRECT
NIT INHB				
NONE	4.04	4.30	6.13	6.73
NITRAPYR	5.35	5.42	6.37	6.71
SOD TRI	4.57	5.01	6.13	6.46

78/R/WW/2 WHITE HORSE I(R)

GRAIN TONNES/HECTARE

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

N TIME DRILLING N FORM(1)	AUTUMN CNVTIAL	SPRING		
		DIRECT	CNVNTIAL	DIRECT
AMMONIA	4.35	4.86	6.17	6.43
UREA	4.95	4.96	6.25	6.84

N TIME DRILLING N RATE	AUTUMN CNVTIAL	SPRING		
		DIRECT	CNVNTIAL	DIRECT
80	4.05	4.53	5.88	6.33
120	5.26	5.29	6.54	6.94

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

TABLE	N FORM(2) DRILLING		N FORM(1) DRILLING	N RATE DRILLING
SED	0.762*		0.220*	0.220*

TABLE	N TIME DRILLING	NIT INHB DRILLING	N FORM(1) N RATE DRILLING	N FORM(1) N TIME DRILLING
SED	0.220*	0.269*	0.311*	0.311*

TABLE	N RATE N TIME DRILLING	N FORM(1) NIT INHB DRILLING	N RATE NIT INHB DRILLING	N TIME NIT INHB DRILLING
SED	0.311*	0.381*	0.381*	0.381*

* ONLY FOR COMPARING THE DIFFERENCE OF TWO EFFECTS OF DRILLING.
THE SED OF SUCH A DIFFERENCE EQUALS 1.4142 TIMES THE SED SHOWN.

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

STRATUM	DF	SE	CV%
WP.SP	9	0.539	9.2
GRAIN MEAN DM% 83.8			
PLOT AREA HARVESTED 0.00279			

78/W/WW/2 HORSEPOOL LANE CLOSE (W)

GRAIN TONNES/HECTARE

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

N FORM(1)	AMMONIA	UREA	MEAN	
NIT INHB				
NONE	6.24	6.25	6.24	
NITRAPYR	6.78	6.30	6.54	
SOD TRI	6.03	6.84	6.44	
MEAN	6.35	6.46	6.41	
N RATE	80	120	MEAN	
NIT INHB				
NONE	6.09	6.40	6.24	
NITRAPYR	5.98	7.10	6.54	
SOD TRI	5.51	7.37	6.44	
MEAN	5.86	6.96	6.41	
N RATE	80	120	MEAN	
N FORM(1)				
AMMONIA	5.70	7.01	6.35	
UREA	6.02	6.91	6.46	
MEAN	5.86	6.96	6.41	
N TIME	AUTUMN	SPRING	MEAN	
NIT INHB				
NONE	6.06	6.42	6.24	
NITRAPYR	6.26	6.83	6.54	
SOD TRI	6.16	6.71	6.44	
MEAN	6.16	6.66	6.41	
N TIME	AUTUMN	SPRING	MEAN	
N FORM(1)				
AMMONIA	6.32	6.38	6.35	
UREA	6.00	6.93	6.46	
MEAN	6.16	6.66	6.41	
N TIME	AUTUMN	SPRING	MEAN	
N RATE				
80	5.06	6.65	5.86	
120	7.26	6.66	6.96	
MEAN	6.16	6.66	6.41	
N FORM(1)	AMMONIA	UREA		
N RATE	80	120	80	120
NIT INHB				
NONE	5.80	6.68	6.38	6.12
NITRAPYR	6.20	7.37	5.77	6.84
SOD TRI	5.09	6.98	5.92	7.76

78/W/WW/2 HORSEPOOL LANE CLOSE (W)

GRAIN TONNES/HECTARE

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

N FORM(1)	AMMONIA		UREA	
N TIME	AUTUMN	SPRING	AUTUMN	SPRING
NIT INHB				
NONE	6.47	6.01	5.66	6.84
NITRAPYR	6.70	6.87	5.82	6.79
SOD TRI	5.79	6.28	6.54	7.15

N RATE	80		120	
N TIME	AUTUMN	SPRING	AUTUMN	SPRING
NIT INHB				
	5.44	6.73	6.68	6.12
NITRAPYR	5.13	6.84	7.39	6.82
SOD TRI	4.62	6.39	7.70	7.04

N RATE	80		120	
N TIME	AUTUMN	SPRING	AUTUMN	SPRING
N FORM(1)				
AMMONIA	4.96	6.43	7.68	6.34
UREA	5.17	6.88	6.84	6.98

N RATE	80		120		
N TIME	AUTUMN	SPRING	AUTUMN	SPRING	
NIT INHB					
NIT INHB	FORM(1)				
NONE	AMMONIA	5.42	6.18	7.52	5.84
	UREA	5.47	7.28	5.84	6.40
NITRAPYR	AMMONIA	5.54	6.86	7.86	6.88
	UREA	4.71	6.83	6.92	6.76
SOD TRI	AMMONIA	3.92	6.25	7.65	6.30
	UREA	5.32	6.53	7.75	7.77

78/W/WW/2/HORSEPOOL LANE CLOSE (W)

GRAIN TONNES/HECTARE

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

N FORM(2)	
0	4.14
NC 70	6.96
NC 80	6.23
NC 90	6.73
NC 100	6.94
NC 110	7.17
NC 120	6.60
NC 130	7.00
A40INC80	7.01
A80INC40	6.68
A40TNC80	7.35
A80TNC40	6.71
U40INC80	7.90
U80INC40	7.31
U40TNC80	6.70
U80TNC40	7.27
AS --120	7.69
AS IC120	7.58
MEAN	6.89
GRAND MEAN	6.41

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

TABLE	N FORM(2)	NIT INHB	N FORM(1)	N RATE
SED	0.867	0.307	0.250	0.250
TABLE	N TIME	NIT INHB N FORM(1)	NIT INHB N RATE	N FORM(1) N RATE
SED	0.250	0.434	0.434	0.354
TABLE	NIT INHB N TIME	N FORM(1) N TIME	N RATE N TIME	NIT INHB N FORM(1) N RATE
SED	0.434	0.354	0.354	0.613
TABLE	NIT INHB N FORM(1) N TIME	NIT INHB N RATE N TIME	N FORM(1) N RATE N TIME	NIT INHB N FORM(1) N RATE N TIME
SED	0.613	0.613	0.501	0.867

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

STRATUM	DF	SE	CV%
BLOCK.WP	41	0.867	13.1
GRAIN MEAN DM%	81.1		
PLOT AREA HARVESTED	0.00279		