




1983

Studies on the effects of nutrition and tillage systems on cereal root diseases

R F. Brennan

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Recommended Citation

Brennan, R F. (1983), *Studies on the effects of nutrition and tillage systems on cereal root diseases*. Department of Agriculture and Food, Western Australia, Perth. Report.

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DEPARTMENT OF AGRICULTURE

STUDIES ON THE EFFECTS OF NUTRITION AND TILLAGE SYSTEMS
ON CEREAL ROOT DISEASES

EXPERIMENTAL RESULTS 1983

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Aim: To determine whether a split application of nitrogen applied four weeks after sowing can improve the effectiveness of take-all control by ammonium nitrogen.

Soil: Brown loamy sand
G. Tyrell, Mt Ridley

Sown: 22/6/83 Wheat (Madden) at 70 kg ha⁻¹

Basals: P at 28 kg ha⁻¹ drilled
N at seeding (25 kg ha⁻¹) TRS 4-15

Harvest: 13/12/83

TABLE 1
Grain yield (t ha⁻¹)

Fertiliser drilled	Nitrogen TD (kg ha ⁻¹)		
	Nil	Urea (33)	Am. sulphate* (71)
Super	0.88	1.10	1.15
18:5	1.16	1.19	1.24
D.A.P.	1.06	1.05	1.11
Agras No. 1	1.14	1.18	1.23
Am. Sul*	1.17	1.24	1.23

* Ammonium Sulphate granulated
Nitrogen topdressed four weeks after sowing

TABLE 2
1,000 Grain yield (grams)
(Mean of 3 reps.)

Fertiliser drilled	Nitrogen TD (kg ha ⁻¹)		
	Nil	Urea (33)	Am. sulphate* (71)
Super	34.83	34.68	35.33
18:5	35.07	32.88	34.30
D.A.P.	35.48	32.74	35.92
Agras No. 1	34.05	33.36	33.83
Am. Sul	34.50	34.26	34.21

TABLE 3
Dry matter production at anthesis (Means)

Fertiliser drilled	Nitrogen TD (kg ha ⁻¹)		
	Nil	Urea (33)	Am. sulphate* (71)
Super	1.52	1.82	1.86
18:5	2.21	2.41	2.41
D.A.P.	2.13	2.23	2.21
Agras No. 1	2.32	2.49	2.43
Am. Sul	2.29	2.50	2.57

- NB: 1. Roots sampled at anthesis for take-all assessment which will not be completed until the return of Dr G. MacNish.
2. Nutrient status and uptakes unavailable at this time as are soil analyses.
3. All data the mean of 3 replicates.

Aim: To determine the effects of rates of nitrogen and phosphorus on the build up of take-all in a virgin soil.

Soil: Grey sand/gravel
High school block

Sown: 14/6/83 Egret at 70 kg ha⁻¹

Basals: CuSO₄ (6.0 kg ha⁻¹)
ZnO (2 kg ha⁻¹)
Mo (80 g ha⁻¹)

Harvest: 12/12/83

TABLE 4
Grain yield (t ha⁻¹)

Super drilled (kg ha ⁻¹)	Rates of nitrogen as urea T.D. (kg ha ⁻¹)			
	0	20	40	80
0	0.36	0.38	0.40	0.39
50	0.50	0.62	0.74	0.82
100	0.62	0.81	0.91	1.00
150	0.66	0.87	1.00	1.13
200	0.73	0.95	1.05	1.15

Nitrogen T.D. 4/7/83

TABLE 5
1,000 Grain yield (grams)

Super drilled (kg ha ⁻¹)	Rates of urea T.D. (kg ha ⁻¹)			
	0	20	40	80
0	33.78	34.93	33.74	32.69
50	34.96	35.87	37.15	34.90
100	36.59	38.35	34.64	35.56
150	38.29	38.97	36.54	35.74
200	38.42	39.05	37.50	35.95

TABLE 6
Plants/metre of row at 2nd leaf stage
(Means)

Super drilled (kg ha ⁻¹)	Rates of urea T.D. (kg ha ⁻¹)			
	0	20	40	80
0	24.7	27.7	25.0	25.3
50	26.3	26.3	26.0	27.7
100	27.0	30.0	26.7	28.0
150	26.3	25.7	26.0	28.0
200	26.3	28.7	26.7	25.0

TABLE 7
Dry matter production at anthesis (t ha⁻¹)

Super drilled (kg ha ⁻¹)	Rates of urea T.D. (kg ha ⁻¹)			
	0	20	40	80
0	1.21	1.44	1.48	1.56
50	1.27	1.71	1.82	1.90
100	1.40	1.98	2.17	2.29
150	1.78	2.18	2.49	2.10
200	1.96	2.46	2.62	2.78

- NB:
1. Roots samples at anthesis for take-all assessment which will not be completed until the return of Dr G. MacNish
 2. Plants sampled for nutrient status during the growing season.
 3. Plants samples for nutrient uptake at anthesis. Chemical analysis of plant samples are as yet not complete.
 4. Soil sampled, site and specific treatments. No data as yet is available.
 5. All data the means of 3 replicates.

Aim: To determine the effects of rates of nitrogen and phosphorus on the build up of take-all in a virgin soil.

Soil: Grey sand/gravel/clay
J. Lay

Sown: 16/6/83 Egret at 70 kg ha⁻¹

Basals: CuSO₄ at 6.0 kg ha⁻¹
ZnO (2 kg ha⁻¹)
Mo (80 g ha⁻¹)

Harvest: 14/12/83

TABLE 8
Grain yield (t ha⁻¹)

Super drilled (kg ha ⁻¹)	Rates of urea T.D. (kg ha ⁻¹)			
	0	20	40	80
0	-	-	-	-
50	0.55	0.62	0.65	0.76
100	0.82	1.00	1.12	1.19
150	0.97	1.25	1.36	1.42
200	1.06	1.35	1.55	1.60

Nitrogen T.D. 4/7/83 at 1¹/₂ leaf stage

TABLE 9
1,000 grain yields (grams)

Super drilled (kg ha ⁻¹)	Rates of urea T.D. (kg ha ⁻¹)			
	0	20	40	80
0	-	-	-	-
50	32.76	33.95	33.06	32.08
100	32.89	33.90	33.37	33.20
150	35.47	34.41	33.06	32.87
200	34.57	34.64	33.62	32.88

TABLE 10
 Dry matter yield (t ha⁻¹) at anthesis

Super drilled (kg ha ⁻¹)	Rates of urea T.D. (kg ha ⁻¹)			
	0	20	40	80
0	0.13	0.15	0.15	0.16
50	1.15	1.72	2.00	2.15
100	1.73	2.40	2.78	2.94
150	2.03	2.90	3.28	3.48
200	2.16	3.24	3.76	4.01

NB: Comments as for previous experiment

Aim: To determine the effects of rates of nitrogen and phosphorus on the build up of take-all in a virgin soil.

Soil: Brown loamy sand
G. Tyrell, Mt Ridley

Sown: 23/6/83 Madden at 70 kg ha⁻¹

Basals: CuSO₄ at 6.0 kg ha⁻¹
ZnO (2 kg ha⁻¹)
Mo (80 g ha⁻¹)

Harvest: 13/12/83

TABLE 11
Grain yield (t ha⁻¹)

Super drilled (kg ha ⁻¹)	Rates of urea T.D. (kg ha ⁻¹)			
	0	20	40	80
0	*NH	NH	NH	NH
50	1.02	0.98	1.04	1.06
100	1.61	1.63	1.66	1.62
150	1.79	1.87	1.92	1.94
200	1.92	1.98	2.05	1.91

*NH: Not harvested, although few small plants with heads were on each nil plot.

TABLE 12
1,000 grain weights (grams)

Super drilled (kg ha ⁻¹)	Rates of urea T.D. (kg ha ⁻¹)			
	0	20	40	80
0	27.09*	26.37*	25.35*	32.86*
50	30.66	31.13	30.71	31.02
100	31.63	32.23	32.40	32.06
150	32.40	32.96	32.75	33.66
200	32.61	34.27	33.08	33.82

* Selected heads from plants that had grown.

TABLE 13
Plants per metre of row at 2nd leaf stage

Super drilled (kg ha ⁻¹)	Rates of urea T.D. (kg ha ⁻¹)			
	0	20	40	80
0	26.3	28.0	28.3	26.3
50	26.7	27.0	28.0	27.7
100	27.0	27.6	27.3	28.0
150	27.3	27.6	27.7	27.3
200	28.0	28.3	27.7	27.7

TABLE 14
Dry matter production (t ha⁻¹) at anthesis

Super drilled (kg ha ⁻¹)	Rates of urea T.D. (kg ha ⁻¹)			
	0	20	40	80
0	0.19	0.25	0.29	0.30
50	1.84	2.11	2.30	2.48
100	2.81	3.36	3.50	3.78
150	3.47	4.11	4.29	4.43
200	3.72	4.27	4.50	4.60

NB: Comments as for previous two experiments

Aim: To study the nutritional and fungicidal effects of copper and zinc on take-all in wheat.

Soil: Grey sand
Neridup, W. Mincherton

Sown: 14/6/83 Egret at 70 kg ha⁻¹

Basals: P = 22.75 kg ha⁻¹
Mo = 80 g ha⁻¹
N = 27.6 kg ha⁻¹

Harvest: 15/12/83

TABLE 15
Grain yield (t ha⁻¹)

		ZnO (kg ha ⁻¹) drilled				
		0	2	4	8	16
CuSO ₄	0	0.62	0.50			
(kg ha ⁻¹)	5	0.85	0.93	0.93	0.94	0.93
drilled	10		0.92			
	15		0.93			
	20		0.92			

TABLE 16
1000 Grain Weights (grams)

		ZnO (kg ha ⁻¹) drilled				
		0	2	4	8	16
CuSO ₄	0	32.99	32.90			
(kg ha ⁻¹)	5	34.10	33.40	34.65	33.21	33.52
drilled	10		33.70			
	15		32.60			
	20		33.81			

TABLE 17
 Dry matter yield (t ha⁻¹) at anthesis

		ZnO (kg ha ⁻¹) drilled				
		0	2	4	8	16
CuSO ₄	0	1.66	1.68			
(kg ha ⁻¹)	5	1.84	2.14	2.36	2.27	2.31
drilled	10		2.14			
	15		2.29			
	20		2.28			

- NB: 1. Roots sampled at anthesis for take-all assessment which will be completed on Dr G. MacNish's return.
2. Nutrient status and uptake unavailable at this time.
3. Soil data not available at this time.
4. All data the mean on 3 replicates.

Aim: To study the nutritional and fungicidal effects of copper and zinc on take-all in wheat.

Soil: Brown loamy sand
G. Tyrell, Mt Ridley

Sown: 22/6/83 Madden at 70 kg ha⁻¹

Basals: P = 23 kg ha⁻¹
Mo = 75 g ha⁻¹
N = 27.6 kg ha⁻¹

Harvest: 13/12/83

TABLE 18
Grain yield (t ha⁻¹)

		ZnO (kg ha ⁻¹) drilled				
		0	2	4	8	16
CuSO ₄	0	1.91	1.89			
(kg ha ⁻¹)	5	1.86	1.91	1.94	1.99	2.00
drilled	10		1.91			
	15		1.94			
	20		1.91			

NB: No response to Cu and Zn

TABLE 19
1,000 grain yields (grams)

		ZnO (kg ha ⁻¹) drilled				
		0	2	4	8	16
CuSO ₄	0	33.05	32.87			
(kg ha ⁻¹)	5	33.22	33.29	32.13	32.11	32.32
drilled	10		33.19			
	15		33.12			
	20		32.75			

TABLE 20
 Dry matter production (t ha⁻¹) at anthesis

		ZnO (kg ha ⁻¹) drilled				
		0	2	4	8	16
CuSO ₄	0	4.41	4.63			
(kg ha ⁻¹)	5	4.46	4.68	4.56	4.55	4.59
drilled	10		4.60			
	15		4.56			
	20		4.61			

- NB: 1. Nutrient status and nutrient uptake unavailable at this time.
2. Soil data unavailable. Chemical analysis incomplete.
3. Roots for take-all assay samples but assessments unavailable until Dr G. MacNish's return.
4. All data is the mean of 3 replicates.

Aim: To determine the residual effectiveness of previously applied copper and to measure the effect of copper applications on the build up of take-all.

Soil: Caitup gravelly sand
EDRS

Sown: 4/7/83 Madden
Resown 17/8/83

Basals: P = 17 kg ha⁻¹
N = 30 kg ha⁻¹

Harvest: 22/12/83

TABLE 21

Treatment	Dry matter (t ha ⁻¹)	Grain yield (kg ha ⁻¹)
1 Nil Cu	1.27	152
2 CuSO ₄ (2.2) (kg ha ⁻¹)	1.47	211
3 " (4.4) "	1.50	292
4 Nil Cu	1.20	80
5 CuSO ₄ (1.1) "	1.43	159
6 " (2.2) "	1.47	180
7 " (4.4) "	1.49	284
8 " (8.8) "	1.50	387
9 ¹ " (2.2) "	1.43	268
10 ¹ " (4.4) "	1.54	412
11 ² " (2.2) "	1.46	277
12 ² " (4.4) "	1.46	364
13 ³ " (2.2) "	1.48	273
14 ³ " (4.4) "	1.52	462

NB: 1 Extra CuSO₄ (2.2), and CuSO₄ (4.4) in 1976
2 Extra CuSO₄ (130 g ha⁻¹) in 68, 69
3 Extra CuSO₄ (260 g ha⁻¹) in 68, 69

Comments:

1. Low grain yields due to late sowing, dry spring and desiantha damage.
2. Nutrient status and uptake unavailable.
3. Trial sampled for root rots; with the same comments as the preceding trials.

Aim: To determine the residual effectiveness of previously applied copper and to measure the effect of copper applications on the build up of take-all.

Soil: Grey sand/gravel
EDRS

Sown: 5/7/83 Madden at 45 kg ha⁻¹

Basals: P = 17 kg ha⁻¹
N = 30 kg ha⁻¹

Harvest: 21/12/83

TABLE 22

Treatment	Dry matter (t ha ⁻¹)	1,000 gram wt (grams)	Grain yield (kg ha ⁻¹)
1 Nil Cu	1.61	33.89	318
2 CuSO ₄ (4.4 kg ha ⁻¹ in 1976)	2.38	33.04	435
3 " (1.1 kg ha ⁻¹ in 1967)	2.37	32.04	397
4 " (2.2 " " ")	2.25	33.36	420
5 " (4.4 " " ")	2.19	33.79	395
6 " (8.8 " " ")	2.20	32.03	421
7 " (4.4 " " ")	2.36	33.48	400
8 " (4.4 " " ")	2.22	32.77	403

NB: TR7 had extra CuSO₄ in 1968, 69, 70 at a rate of 275 g ha⁻¹

TR8 had extra CuSO₄ in 1968, 69, 70 at a rate of 550 g ha⁻¹

Comments:

1. High variability and low grain yields due to late sowing, water logging in late July, extensive desiantha damage and a dry finish to the season.
2. Nutrient status and uptake unavailable.
3. Trial sampled for root rots; with the same comments as the preceding trials.

Aim: To study the effect of repeated use of different nitrogen sources on the incidence and build up of take-all in wheat.

Soil: Grey sand/gravel/clay
EDRS

Trial: Commenced by Dr G. MacNish

Basals: P = 29 kg ha⁻¹
N₂ = 25 kg ha⁻¹

TABLE 23

Treatment	Dry matter production (t ha ⁻¹)	1,000 grain wt (grams)
1. Super	0.82	33.39
2. NaNO ₃	1.15	32.79
3. Agron 34	1.02	34.49
4. Urea	0.97	35.31
5. Am. Sul.	1.48	35.61
6. Agras No. 1	1.49	35.18
7. Agras No. 2	1.44	34.15
8. D.A.P.	1.15	34.50

Dry matter production and root sampling taken at anthesis.

Grain yield see Dr G. MacNish annual summary.

10. ROOT ROT SURVEY: WEST OF GIBSON

TABLE 24

Area	Crop	Soil	Weeds	Take-all assessment			
				Nil	L	M	S
Esperance	W/P	Sand	Mod	20			
to	B/G	Sandy L	Few	38	1	1	
Cascades	B/P	Sand	Many	37			
to	W/G	Sandy gravel	Few	20	5		
West	W/P	" "	Few	22	2		
Point	W/P	" "	Mod	15			
sampled	W/G	Loamy sand	Few	27	1		
approx.	W/G	" "	Few	28			
every	W/P	Loam	Mod	24	2		
10 kms	B/G	Loamy gravel	Few	19			
	W/G	Loamy sand	Few	33			
	B/G	" "	Few	12	4		

NB: W = wheat
 B = barley
 P = poor growth
 G = good growth, even height, good tillering

Few weeds - includes crop with no weeds
 Mod. weeds - few patches with small effect on crop
 Many weeds - likely to be causing reduction in yield

Presence or absence of stubble and type of stubble also noted

See notes on take-all assessment under Table 25

11. ROOT ROT SURVEY: EAST OF GIBSON

TABLE 25

Area	Crop	Soil	Weeds	Take-all assessment			
				Nil	L	M	S
Esperance	B/G	Sand	Mod	42	1		
to	B/G	Sandy gravel	Few	25			
Howick	W/G	Sand	Mod	51			
and	B/G	Sandy gravel	Few	43	1		
return	B/G	Sand	Few	45			
Fisheries	W/P	Loamy clay	Few	23	2		
Road	B/G	Sandy gravel	Few	60	1		
sampled	B/G	Sand	Few	49			
every	W/G	Sand	Few	40	1		
10 kms	B/G	Sand	Few	52			
(approx.)	B/G	Sandy gravel	Few	18			

NB: 1. Abbreviations and codes as for previous table.

2. Take-all assessment is the number of plant samples in each class.

Each class being:-

- (1) Nil: no obvious infection
- (2) Light (L): less than 25% of the root system discoloured.
- (3) Moderate (M): 25 to 75% of the root system discoloured, stem base sometimes discoloured.
- (4) Severe: more than 75% of the root system discoloured, stem base usually discoloured.