1984

Manganese nutrition of cereals

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Manganese Nutrition of Cereals
Experimental Results
1984/85

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1. Acidifying N Fertilizers On Availability Of Native Soil Mn, And On Fertilizer Mn Applied In Two Forms And Two Mixing Methods

84NO3/1509 Ex

Aim: To determine the influence of nitrogen fertilizer, Mn source and mixing method on the utilisation of soil and fertilizer Mn by wheat.

Location: B. Schillings, Dale.

Soil: Brown gravelly sand.

Vegetation: White gum, some spotted gum nearby.

History: Probably cleared about 15 years, cereal crop-sub. clover rotation with relatively low phosphate status. '82 wheat; '83 lupins. Said to have had some manganese application of undetermined rate and form in '82.

1984 Results: Sown 4.6.84. Harvested 17.12.84
Basals P 13.65 kg ha
N 22.5 as urea T.D. 4 W.A.S.
Sprayseed 2 L ha 28.5.84
Eradu wheat 50 kg ha
Weed control good.

Table 1. Effects of acidifying nitrogen fertilizers on the uptake of manganese by wheat from native soil supplies and fertilizer manganese supplied as sulphate or an oxide, either dry mixed or incorporated into the fertilizer granule (see* footnote). Wheat grain yields t/ha.

	Mn rates in Mn SO_4 equivalent				
		Mn SO_4 15		Mn Oxide = 15	
P & N Fertilizer	Nil	Dry	Wet	Dry	Wet
84NO3, Rep 1, B. Schillings					
Super 150 (13.7 P)	1.5	2.2	1.9	2.0	2.1
Super 150 + S.A (31.5 N)	1.7	2.4	2.4	2.4	2.4
Agras 180 (= P & N)	2.0	2.0	2.2		
Super 150 + Urea (31.5 N)	1.7	2.2	2.3		
84NO3, Mean of 3 reps					
Super 150 (13.7 P)	1.9	2.2	2.2	2.1	2.1
Super 150 + S/A (31.5 N)	2.3	2.5	2.5	2.4	2.4
Agras 180 (= P & N)	2.2	2.2	2.4		
Super 150 + Urea (31.5 N)	2.1	2.5	2.5		

* Explanation of fertilizer treatments.

Superphosphate, superphosphate + Mn sources dry mixed in concrete mixer, and superphosphate + Mn sources added to fresh moist superphosphate in concrete mixer at Albany works and granulated, all drilled with wheat seed.

Superphosphate + ammonium sulphate, with or without Mn sources dry or wet, prepared and drilled with seed as above.

Agras 18 + Mn sources mixed wet were prepared by wetting the Agras with water in a concrete mixer, adding the Mn and then tumbling in the mixer. The aim was to get adhesion of the Mn onto the Agras but this was variable and only partially satisfactory. All Agras treatments were drilled with seed. The Agras was Agras No. 1 (17.5% N, 16% S, 7.6% P).

For the super and urea treatments the urea was not mixed with the other fertilizer. The urea was topdressed after seeding the various superphosphate mixtures which were prepared and applied as for the superphosphate - no nitrogen treatments.

Comments on results:

1. Chemical analyses of whole tops and YEBs sampled twice in the growing period are needed before a more definitive interpretation is possible.

2. The distribution of manganese deficiency between reps. was uneven - Rep 1 and most of Rep 2 showed clear Mn deficiency while it was difficult to detect Mn deficiency in Rep 3.

3. Mn Sources - Mn sulphate usually appeared slightly better than Mn oxide.

4. Mn Methods - Little apparent difference between methods of incorporation of the manganese.

5. Nitrogen Fertilizer Effects - In effect on increasing Mn uptake from both native and fertilizer ammonium sulphate appeared to have slightly larger effects than Agras No. 1 which in turn had larger effects than urea. These differences are not consistently reflected in grain yields.

As with the other 1984 Mn experiments clearer definition of treatment effects awaits our receival of chemical analyses of plants sampled two or three times in the growing season for whole tops and YEBs.

1. <u>Acidifying N Fertilizers Mn Sources, Methods of Incorporation</u>

84N04/1509 Ex

<u>Aim</u>: As for 84N03.

<u>Location</u>: E. Crisp, Dale.

<u>Soil</u>: Grey to brown sand or gravelly sand over brown sandy gravel.

<u>Vegetation</u>: White gum.

<u>History</u> Wheat 1983 possibly with Mn spray. Sub. clover in 1982. Full history not known.

1984 Results: Sown 3.6.84. Harvested 13.12.84. Weed control was somewhat variable with some fairly dense patches of sub. clover in some plots. Other basals as for 84NO3.

Table 2. 84NO4. Effects of acidifying nitrogen fertilizers on the uptake of manganese by wheat from native soil supplies and fertilizer manganese supplied as sulphate or an oxide, either dry mixed or incorporated into the fertilizer granule (see* footnote).
Wheat grain yields t/ha.

		Mn rates in Mn SO_4 equivalent			
		Mn SO_4 15		Mn Oxide = 15	
P & N Fertilizer	Nil	Dry	Wet	Dry	Wet
Super 150 (13.7 P)	0.9	1.4	1.5	1.6	1.2
Super 150 + S/A (31.5 N)	1.7	2.0	1.9	1.8	1.7
Agras 180 (= P & N)	1.5	1.9	1.9	-	-
Super 150 + Urea (31.5 N)	1.5	1.6	1.5	-	-

* Fertiliser preparations and treatment as for 84NO3.

1. Chemical analyses of plant samples are needed for a more definitive interpretation.

2. Manganese deficiency was typically somewhat patchy. On the nil nitrogen treatments, plant growth was clearly limited by a relatively low nitrogen supply. In the presence of applied Mn there was a marked grain yield response to N supplied as S/A or Agras No. 1 but not to urea. In the vegetative stage this response appeared to be mainly due to the alleviation of N deficiency rather than Mn deficiency. The apparent inferiority of urea in the plus Mn treatments is difficult to understand particularly as urea appeared to increase the uptake of native Mn to a much greater extent than has been observed in other situations. Perhaps there was greater downward movement of topdressed urea into the root zone than usual, resulting in a larger than usual effect on Mn availability but also in some loss of N by leaching.

3. Mn Sources - Mn sulphate tended to appear slightly better than Mn oxide.

4. Mn Methods - Overall there was little apparent difference between methods of incorporation of Mn fertilizer.

5. N Fertilizer Effects on Mn Availability. Ammonium sulphate appeared to be superior to Agras No. 1 and urea in alleviating Mn deficiency. However both Agras and urea clearly reduced Mn deficiency and in the absence of Mn fertilizer, application increased grain yield by 0.6 t ha through the combined effects of increased Mn and N uptake. See also point 2 above.

3. Acidifying N Fertilizers, Mn Sources, Methods of Incorporation

84N05/1509 Ex

Aim: As for 84N03.

Location: R. Huddleston, Dale.

Soil: Brown lateritic gravelly loamy sand.

Vegegation: White gum.

History: Wheat 1983 possibly with Mn spray. Full history not known.

1984 Results: Sown 3.6.84. Harvested 13.12.84.
Sprayseed 750 ml/ha 26.5.84
Other basals as for 84N03.

Grazed bare by sheep inadvertently about 5 weeks after seeding which severely reduced dry matter and grain production. Grass weeks became obvious towards the end of the season.

Table 3. 84N05. Effects of acidifying nitrogen fertilizers on the uptake of manganese by wheat from native soil supplies and fertilizer manganese supplied as sulphate or an oxide, either dry mixed or incorporated into the fertilizer granule (see* footnote). Wheat grain yields t/ha.

		Mn rates in Mn SO_4 equivalent			
		Mn SO_4 15		Mn Oxide = 15	
P & N Fertilizer	Nil	Dry	Wet	Dry	Wet
Super 159 (13.7 P)	0.6	0.7	0.8	0.8	0.7
Super 150 + S/A (31.5 N)	0.9	1.1	1.0	1.0	1.0
Agras 180 (= P & N)	0.8	0.9	1.0	-	-
Super 150 + Urea (31.5 N)	0.7	0.9	0.9	-	-

* Fertilizer preparation and treatment as for 84N03.

1. Chemical analyses of plant samples are needed for a more definitive interpretation.

2. Although sheep removed the early growth, depressing total dry matter production and grain yield, the trends in treatment effects in this experiment were in line with the other experiments.

3. Mn Sources - Differences between sources were slight with some suggestion that the sulphate was a little more effective than the oxide.

4. Mn Methods - Differences were not clear.

5. N Fertilizer Effects. In reducing Mn deficiency in the absence of Mn fertilizer, S/A was better than Agras which was better than urea. Where Mn fertilizer was applied S/A was superior but there was little difference between Agras and urea in their apparent effects on either Mn or N supply.

4. Varietal Differences Among Wheats In Ability To Absorb And Utilize Manganese In Deficiency Situations

84N06/1509 Ex

Aim: To compare recommended wheat varieties in their abilities to absorb and utilize native and fertilizer manganese in a deficiency situation.

Location: R. Huddleston, Dale.

Soil: Brown gravelly loamy sand.

Vegetation: White gum, spotted gum.

History: Pasture 1983.

1984 Results: Sown 2.6.84. Harvested 13.12.84.
Sprayseed 750 ml/ha 26.5.84.
Basals: Urea 150 kg/ha T.D. before seeding. Super 150 kg/ha.
Seeding rate 50 kg/ha all varieties.
Weed control acceptable.

Table 4. Grain yields (t/ha) of wheat varieties with and without manganese sulphate (20 kg/ha) Expt. 84NO6.

Wheat variety	Manganese sulphate (kg/ha) 0	20	Response to manganese
Millewa	2.03	1.84	-0.19
Gamenya	1.83	1.72	-0.11
Bodallin	1.79	1.80	-0.01
Lance	1.41	1.47	0.06
Canna	1.78	1.83	0.05
Bokal	1.51	1.57	0.06
Gutha	1.53	1.64	0.11
Egret	1.69	1.81	0.12
Madden	1.66	1.79	0.13
Jacup	1.58	1.73	0.15
Miling	1.90	2.06	0.16
Eradu	1.64	1.86	0.22
Aroona	1.67	1.90	0.23
Tincurrin	1.95	2.19	0.24

Urea at 150 kg/ha was topdressed across all plots before seeding as the experiment was originally planned for a site which had been cropped to cereals the previous year and we did not want vegetative growth to be limited by nitrogen deficiency. However the experiment had to be sown on an area that was in sub clover pasture in 1983. The use of such a high rate of urea topdressed <u>before</u> drilling (hence some incorporation) was in retrospect a mistake to the extent that this urea treatment appeared to significantly increase the availability of native soil manganese and there was little visual evidence of manganese in the experiment while there were extensive patches of manganese deficiency in the farmer's wheat crop, surrounding and adjoining the experiment. Basal super 150 kg/ha.

Comments on 1984 results.

1. Mn application gave small mean increase over all varieties of about 0.1 t/ha.

2. Some of the apparent differences between varieties are likely to be due to within experiment variation. Analyses of plant samples are required for further assessment of varietal differences.

3. Tincurrin, Aroona and Eradu appeared most responsive to Mn and hence posibly most sensitive to Mn deficiency.

4. Millewa, Gamenya and Bodallin appeared least sensitive to Mn deficiency.

5. <u>Manganese Residual With Acidifying Nitrogen Fertilizers</u>

   84N07/1509 Ex

<u>Aim</u>: To measure the residual effectiveness of rates of manganese fertilizer with two nitrogen fertilizer sources differing in degree of acidifying effect.

<u>Location</u>: R. Huddleston, Dale.

<u>Soil</u>: Brown gravelly loamy sand.

<u>Vegetation</u>: White gum.

<u>History</u>: Pasture 1983.

<u>1984 Results</u>: Sown 3.6.84. Harvested 13.12.84.
Sprayseed 750 ml/ha 26.5.84.
Weed control reasonable.

Table 5. Manganese residual with acidifying nitrogen fertilizer. 1st year results 1984 - 84NO7.

Manganese Sulphate kg/ha	Phosphorous and Nitrogen Fertilizer kg/ha Super 150 + Urea 68.5	Agras No. 1 180
0	1.81	2.04
15	2.13	2.10
30	2.10	2.16
60	2.20	2.14

Urea was topdressed immediately after seeding.
Manganese sulphate was mixed dry with either the superphosphate or Agras No. 1 and drilled with the wheat seed.
Variety: Eradu.

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1. Degree of Mn deficiency was slight but experienced observers could pick all the nil Mn super-urea plots and most of the nil Mn Agras No. 1 plots.

2. Mn application increased grain yield by about 0.3 t/ha with super-urea and 0.1 t/ha with Agras.

3. Provision is made in the experimental design for the residual effectiveness of the Mn application to be measured in three future years.

<u>Manganese concentrations in parts of YEBs</u> from 10 plants per plot from selected treatments of 84NO7. Sampled and analysed by Murdoch University group.

Table 6. Manganese concentration in sections of youngest open blades of wheat sampled 17/9/84 from 84NO7. Sampled and analysed by Murdoch University group. Mn in µg Mn/g DM.

	Mn sulphate Nil (Super + Urea)						Mn sulphate 15 kg/ha				
Plot No.	Plant No.	B	M	T	Whole Blade	Plot No.	Plant No.	B	M	T	Whole Blade
6	8	2	5	10	5	7	2	5	7	14	8
	9	3	6	8	5		8	6	8	13	9
	7	3	6	13	7		5	6	9	16	9
	5	4	5	9	6		10	6	9	15	9
	3	4	7	10	7		1	9	11	18	12
	6	5	8	11	7		7	10	13	26	15
	1	5	10	14	9		9	10	13	23	14
	4	6	9	13	9		3	14	23	39	24
	2	8	12	22	13		4	14	21	40	22
	10	8	13	26	14		6	28	32	49	35
	Mean	5	8	14	8			11	16	25	16
28	10	1	5	8	4	29	6	4	8	16	9
	3	2	5	10	5		2	5	7	11	7
	5	4	7	11	7		7	5	7	13	8
	4	4	7	15	8		8	7	9	25	13
	7	4	7	12	7		3	7	11	24	12
	6	4	7	17	8		10	7	8	20	11
	9	5	7	15	9		5	9	11	18	12
	2	7	10	20	12		9	11	15	30	17
	1	8	11	-	(9)		1	11	14	34	17
	8	12	17	32	19		4	18	26	51	29
	Mean	5	8	15	9			8	12	24	13

Table 6 (cont'd)

Plot No.	Mn sulphate Nil (Super + Urea) Plant No.	B	M	T	Whole Blade	Plot No.	Mn sulphate 15 kg/ha Plant No.	B	M	T	Whole Blade
39	2	4	5	8	5	44	10	3	7	11	6
	4	6	9	14	9		5	4	7	12	7
	8	6	7	9	7		6	5	8	10	7
	5	7	11	14	10		9	5	7	9	6
	7	7	9	14	10		4	6	9	16	10
	1	8	10	17	11		8	6	11	26	12
	3	9	12	19	12		3	10	14	23	14
	6	14	16	21	16		7	10	13	18	13
	9	20	13	16	16		1	10	15	24	16
	10	27	17	26	23		2	11	14	19	16
	Mean	11	11	16	12			7	10	17	11
All Reps		7	9	15	10	All Reps		9	12	22	13

Plot No.	Mn Sulphate 60 kg/ha Plant No.	B	M	T	Whole Blade
16	1	4	6	12	7
	10	9	13	23	14
	3	9	15	27	15
	6	12	15	24	16
	5	12	14	29	17
	9	13	15	24	16
	2	13	19	25	18
	4	17	21	27	21
	8	17	24	37	25
	7	26	37	70	42
	Mean	13	18	30	19
20	7	5	10	18	10
	10	6	7	15	9
	2	7	11	21	12
	5	8	12	26	4
	8	9	13	24	14
	3	10	15	35	18
	9	11	10	25	14
	1	14	21	39	23
	4	22	26	58	34
	Mean	10	13	28	16
48	8	3	4	12	6
	5	5	9	18	10
	1	5	8	15	9
	3	7	9	16	10
	7	13	16	26	18
	6	15	19	35	22
	4	17	20	31	22
	10	17	29	54	30
	9	19	25	42	26
	2	19	27	49	31
	Mean	12	16	30	18
All Reps		12	16	29	18

Comments on Mn concentrations in YEBs 84N07 (Table 6).

1. Note heterogeneity between base, middle and tip of individual leaves in Mn cone. Care needed not to miss any part of base in taking whole YEB.

2. Note heterogeneity between individual plants. Bulk sample may show apparently adequate levels of Mn but contain some deficient plants.

3. The 15 kg/ha Mn sulphate gave maximum yields while the nil Mn rate gave about 15% less grain. The Mn concentrations of YEBs from these treatments were 13 and 10 ppm Mn respectively i.e. the separation was relatively small.

4. The yield reduction of 15% was associated with patches of plants clearly showing the symptoms of Mn deficiency.