1983

Molybdenum nutrition

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EXPERIMENTAL RESULTS 1984

MOLYBDENUM NUTRITION

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CONTENTS

Field Trials

Glasshouse Trials

1. MOLYBDENUM AND AMMONIUM SULPHATE ON WHEAT

81NO40/1213 EX

Aim — To determine the response of wheat to Molybdenum at different rates of S/A at this site where low Mo levels were found in wheat samples

Location — A.R. Uphill & Co, Tammin

Soil — Hard setting yellow sandy loam

Sown — June 12, 1983

Harvested — December 5, 1983

Basals — Superphosphate 150 kg/ha
Agran 34 150 kg/ha
Gamenya wheat 50 kg/ha

Table 1 The effect of Molybdenum and S/A applications on wheat grain yield (t/ha).

Treatment 1981		1982	1983	Grain yield	% Maximum
1. Nil S/A,	Nil Mo	-	-	0.73	76
2. "	Mo (180)	-	-	0.86	90
3. "	Mo (360)	-	-	0.91	95
4. S/A (120),	Nil Mo	Mo (180)	-	0.83	86
5. "	Mo (180)	-	-	0.88	92
6. "	Mo (360)	-	-	0.93	97
7. S/A (240),	Nil Mo	-	Mo (180)	0.96	100
8. "	Mo (180)	-	-	0.86	90
9. "	Mo (360)	-	-	0.84	88

Mo as g MoO_3/ha
S/A as kg/ha

Tissue analyses for Mo concentrations are unavailable at this stage

Results indicate

1. Maximum grain yield was obtained with the current year of Mo application.

2. Even after one year, it appears that the 1982 application of 180 g MoO_3/ha was not as effective in obtaining maximum grain yield as the 1983 application.

2. FOLIAR APPLICATIONS OF MOLYBDENUM ON WEHAT

83TS4/1213 EX

Aim — To examine and compare the responses of Mo deficient wheat to drilled Mo and Mo sprays

Location — Innis - East Perenjori

Basals — Wheat 50 kg/ha
Superphosphate Cu, Zn - A 200 kg/ha
Agran - 34 75 kg/ha

Table 2 The effects of form, amount, time and method of Molybdenum application and vehicle run-over on wheat yield (kg/ha)

Treatment	Method Application	Form Molybdenum	Time Application	Amount (g Mo/ha)	Grain Yield
1.	-	-	-	Nil	267
13.	Vehicle run-over	-	1	Nil	495
14.	Vehicle run-over	-	2	Nil	362
2.	Drilled	Na_2MoO_4	Seeding	75	495
3.	Spray	Na_2MoO_4	1	10	400
4.	"	"	"	25	571
5.	"	"	"	75	648
6.	"	Molytrac	"	10	324
7.	"	"	"	25	476
8.	"	"	"	75	571
11.	TR2 + TR4				628
12.	TR2 + TR7				571
9.	Spray	Na_2MoO_4	2	25	362
10.	"	Molytrac	2	25	381

Time 1 : Wheat stage 6, prior to last leaf emergence
Time 2 : Wheat stage 10, boot.

Grain yield results are variable within treatments due to the site being sandblasted early in the year, being subjected to periods of water stress, and to being damaged from washaways during unseasonal heavy rain in November.

Until chemical analyses for tissue concentrations of Molybdenum are available, little can be concluded from the trial except to say the site did appear deficient in Molybdenum for maximum grain production.

3. FOLIAR APPLICATIONS OF MOLYBDENUM ON WHEAT

83ME7/1213 EX

Aim To determine and compare the responses of Mo deficient wheat to drilled Mo and Mo sprays

Location Leibeck - Muntagin

Soil Wodgil
0-10 cm pH (0.01 M $CaCl_2$) : 4.46
20-30 cm : 4.12

Sown June 22, 1983

Harvested December 6, 1983

Basals Wheat 50 kg/ha
Super - Cu, Zn - A 200 kg/ha
Agran 34 75 kg/ha

Table 3 The effects of form, amount, time and method of molybdenum application and vehicle run-over on wheat yield (t/ha)

Treatment	Method Application	Form Molybdenum	Time Application	Amount (gMo/ha)	Grain Yield	% Maximum
1.	-	-	-	Nil	1.06	92
13.	Vehicle run-over	-	1	"	1.06	92
14.	"	-	2	"	0.92 (1.06)	80 (92)
2	Drilled	Na_2MoO_4	Seeding	75	1.06	92
3.	Spray	Na_2MoO_4	1	10	0.99	86
4.	"	"	"	25	1.15	100
5.	"	"	"	75	1.01	88
6.	"	Molytrac	"	10	1.01	88
7.	"	"	"	25	1.01	88
8.	"	"	"	75	0.91	80
11.	TR2 + TR4				0.95 (1.01)	83 (88)
12.	TR2 + TR7				1.01 (1.07)	88 (93)
9.	Spray	Na_2MoO_4	2	25	0.93	81
10.	"	Molytrac	2	25	0.99	86

Time 1: Wheat stage 6, prior to last leaf emergence
Time 2: Wheat stage 10, boot

( ) Treatments at time 2 adjusted to compensate yield loss from spray-tank tyre run-over.

Little can be concluded from this trial until results of chemical analyses of tissues for Mo concentrations are available. It does appear however, that this site was not as deficient in Mo for maximum grain production as first thought.

4. RESIDUAL VALUE OF MOLYBDENUM ON AN ACID SOIL

81M2/1213 EX

Aim — To measure the rate of decline in effectiveness of fertilizer Molybdenum at this site

Location — Merredin Research Station

Soil — Wodgil

Table 4 The effect of Molybdenum and lime application on grain yield (t/ha) and Mo concentration (ppm) in Y.E.B., whole tops, and grain for 1982.

Treatment	Mo	Lime	Grain Yield	% Maximum	Mo Y.E.B. T1	Mo TOPS T1	Mo TOPS T2	Mo Grain
3-7	Nil	Nil	0.99	97	0.05	0.06	0.04	0.016
9,10	Nil	+	0.92	90	0.06	0.06	0.06	0.021
1	1981	Nil	1.02	100	0.21	0.18	0.14	0.122
8	1981	+	0.94	92	0.16	0.18	0.12	0.110
2	1982	Nil	0.93	91	0.28	0.30	0.18	0.152

T1 : 8/9/1982 : Stage 8; Flag leaf just out
T2 : 8/10/1982: Stage 13, anthesis

Mo : 165 g Mo/ha as MoO_3
Lime: 60 kg/ha

Table 5 Whole top and grain uptakes (g/ha) of Molybdenum for 1982

Treatment	Mo	Lime	Dry weight tops at anthesis (t/ha)	Mo Conc. (µg/g)	Mo uptake in tops (g/ha)	Mo uptake in grain (g/ha)
7	Nil	Nil	2.45	0.04	0.10	0.016
10	Nil	+	2.69	0.06	0.16	0.019
1	1981	Nil	2.44	0.14	0.34	0.124
8	1981	+	2.27	0.12	0.27	0.103
2	1982	Nil	2.37	0.18	0.43	0.141

Results indicate

1. Although the Y.E.B. Mo concentrations in the plots with no added Mo are low (0.05 and 0.06 ppm) there is no grain yield (table 4) or dry matter (table 5) response to the addition of Mo.

2. The small addition of lime had little effect on the uptake of Mo.

3. The uptake of Mo and the concentration of Mo in the Y.E.B. and tops was lower with the 1981 application of Mo than the 1982 application of an equivalent amount of Mo. This indicates a decline in the relative effectiveness of soil applied Molybdenum in one year. The Y.E.B. Mo concentration of the treatment with Mo applied in 1981 shows that it is still above the critical level.

4. The concentration of Mo in the wheat tops declines as the plant develops from stage 8-13 (Feekes scale).

Table 6 The effect of Molybdenum and lime application on grain yield (t/ha) and dry weight of whole tops (t/ha) for 1983

Treatment	Mo	Lime	Grain Yield	% Maximum	Whole Tops
4-7	Nil	Nil	0.88	96	2.47
9,10	Nil	+	0.88	96	2.34
1	1981	Nil	0.91	99	2.59
8	1981	+	0.86	93	2.38
2	1982	Nil	0.88	96	2.32
3	1983	Nil	0.92	100	2.39

Mo : 165 g Mo/ha at MoO_3
Lime: 60 kg/ha

Tissue analyses for Mo levels are unavailable at this stage.

5. RESIDUAL VALUE OF MOLYBDENUM ON AN ACID SOIL

81LG12/1213 EX

Aim To measure the rate of decline in effectiveness of fertilizer Molybdenum at this site

Location K. Radbourne - E. Hyden

Soil Wodgil
0-10 cm pH (1 + 5) 5.2
(1+5) 0.01 M $CaCl_2$ 4.6

Table 7 The effect of Molybdenum and lime application on grain yield (t/ha) and Mo concentration (ppm) in Y.E.B. whole tops, and grain for 1982

Treatment	Mo	Lime	Grain Yield	% Maximum	Mo Y.E.B. T1	T1	Mo TOPS T2	Mo Grain
3-7	Nil	Nil	0.37	90	0.02	0.02	0.01	0.12
9-10	Nil	+	0.41	100	0.02	0.01	0.02	0.16
1	1981	Nil	0.41	100	0.22	0.12	0.10	0.15
8	1981	+	0.38	93	0.22	0.16	0.10	0.15
2	1982	Nil	0.40	98	0.32	0.20	0.19	0.25

T1 : 8/9/82 : stage 9 : flag leaf fully emerged
T2 : 8/10/82: stage 12 : flowering

Mo ; 100 g Mo/ha as MoO_3
Lime: 60 kg/ha

Table 8 Whole top and grain uptakes (g/ha) of Molybdenum for 1982

Treatment	Mo	Lime	Dry weight tops at anthesis (t/ha)	Mo Conc. (µg/g)	Mo uptake in tops (g/ha)	Mo uptake in grain (g/ha)
7	Nil	Nil	1.30	0.01	0.01	0.044
10	Nil	+	1.12	0.02	0.02	0.066
1	1981	Nil	1.22	0.10	0.12	0.062
8	1981	+	1.26	0.10	0.13	0.057
2	1982	Nil	1.15	0.19	0.22	0.100

Observations

The trial suffered from periods of prolonged water stress throughout the growing season and was complicated by the intrusion of self-sown wheat and uneven drill run.

Results indicate

1. Although the Y.E.B. Mo concentrations (0.02 ppm) in the plots with no added Mo are well below the critical level, there is no grain yield (Table 7) or dry matter (Table 8) response to the addition of Mo. The condition of drought may have precluded the expected response.

2. The small addition of lime had little effect on the concentration or uptake of Mo in the whole tops and grain.

3. The uptake of Mo and the concentration of Mo in the Y.E.B. and tops was lower in the 1981 application of Mo than the 1982 application of an equivalent amount of Mo. This indicates a decline in the relative effectiveness of soil applied Mo in one year, but its concentration in the Y.E.B. is still adequate.

1983 Results

Unfortunately this trial was non-harvestable due to severe drought. Chemical analyses of tissues sampled at earlier stages of growth should yield some useful information but are not available at this stage.

6. RESIDUAL VALUE OF MOLYBDENUM ON AN ACID SOIL

83ME82/1213 EX

Aim	To determine and compare the responses by wheat to Mo applied in 1982 and 1983.
Location	K. Chance - Carrabin (near 83ME10)
Soil	Wodgil 0-10 cm pH (1 + 5) 0.01 M $CaCl_2$: 4.65
Sown	June 21, 1983
Harvested	December 19, 1983

Table 9 The effect of year of Mo application on grain yield (kg/ha)

Treatment	Grain Yield	% Maximum
1. Mo (80 g) in super-Mo 1982	362	90
2. Mo (80 g) as Na_2MoO_4 1983	402	100

7. MOLYBDENUM RESPONSES IN WHEAT AND LUPINS

83ME10/ 1213 EX

Aim To compare the response curves of yield and Mo concentration to the application of Mo for wheat and lupins

Location K. Chance - Carrabin

Soil Wodgil
0-10 cm pH (1 + 5) 0.01 M $CaCl_2$; 4.65

Sown June 21, 1983

Harvested Lupins - November 29, 1983

Wheat - December 19, 1983

Table 10 The effect of rates of Mo application on the vegetative and grain yields (t/ha) of wheat and lupins

Treatment		Dry weight tops at flowering	Grain Yield
1. Wheat + N		1.77	0.84
2. "	+ Mo (10)	1.98	0.89
3. "	+ Mo (25)	2.12	0.90
4. "	+ Mo (75)	2.17	1.08
5. "	+ Mo (150)	1.95	0.86
6. Lupins + N		1.08	0.29
7. "	+ Mo (10)	1.37	0.37
8. "	+ Mo (25)	1.07	0.31
9. "	+ Mo (75)	1.07	0.31
10. "	+ Mo (150)	1.18	0.31
11. Lupins inoculated		1.48	0.43
12. "	+ Mo (10)	1.41	0.47
13. "	+ Mo (25)	1.39	0.39
14. "	+ Mo (75)	1.47	0.43
15. "	+ Mo (150)	1.69	0.43

g Mo/ha as Na_2MoO_4
N : 200 kg/ha $NaNO_3$

Observations

Problems occurred with depth control of cone seeder, patchy germination and inoculation of lupins, and insufficient supply of P for lupins on newland.

1. THE RESPONSE OF WHEAT TO MOLYBDENUM ON ELEVEN ACID SANDY SOILS

83GL1

Aim To define the Molybdenum response curves of wheat grown on 11 acid sandy soils.

Location Glasshouse B2 - University of W.A.

Table 1 The effect of amount of soil applied Molybdenum on the dry weight of tops (g/pot) and the Y.E.B. Mo concentration (µg/g).

Soil & pH	Mo Level	Leaf Stage	Dry weight 5 whole tops	% maximum	Y.E.B. Mo concentration
Pindar	0	3-3 1/2	0.22	73	3
Brown sand	50	"	0.30	100	40
5.0/4.4	100	"	0.25	83	11
	200	"	0.26	87	50
	400	"	0.28	93	180
West Binnu	0	4 1/2	1.18	87	64
Grey sand	50	"	1.21	89	389
- Topsoil	100	"	1.26	93	658
5.8/5.0	200	"	1.22	90	1097
	400	"	1.36	100	2286
- subsoil	0	4 1/2	0.94	84	268
6.1/5.2	50	"	1.12	100	1266
	100	"	0.93	83	2202
	200	"	0.92	82	5808
	400	"	0.92	82	8882
Lancelin	0	4 1/2	0.99	92	96
Brown sand	50	"	1.07	99	310
6.0/5.0	100	"	0.95	88	572
	200	"	1.05	97	1112
	400	"	1.08	100	3055
Badgingarra	0	4 1/2	0.84	85	102
Grey sand	50	"	0.99	100	736
6.0/4.9	100	"	0.98	99	1080
	200	4 1/2-4 3/4	0.99	100	2404
	400	"	0.97	98	4290
Wyalkatchem	0	4 1/2	0.50	67	25
Grey gritty sand	50	"	0.65	87	227
5.4/4.4	100	"	0.75	99	640
	200	"	0.72	96	1833
	400	"	0.75	100	3176

East Busselton	0	4	0.80	68	20
Mungite grey	50	"	1.09	92	84
sandy loam	100	4 1/2	1.16	98	188
5.0/4.3	200	"	1.13	96	368
	400	"	1.18	100	511
Bodallin	0	3 3/4-4	0.34	61	23
Yellow sand	50	4	0.50	89	18
5.2/4.4	100	"	0.53	95	25
	200	"	0.54	96	30
	400	"	0.56	100	93
Wongan Hills	0	4 1/2	1.08	85	146
Brown/grey	50	"	1.27	100	1612
sand	100	4 3/4	1.25	98	3451
5.3/4.5	200	"	1.25	98	6757
	400	"	1.17	92	12712
Wongan Hills	0	4	0.42	38	24
Yellow sandy loam	50	4 1/2	0.96	86	143
5.4/4.6	100	"	1.03	92	307
	200	"	1.07	96	1060
	400	"	1.12	100	3012
Redmond	0	4	0.48	94	22
Peaty sand	50	"	0.51	98	53
4.8/4.1	100	"	0.52	100	117
	200	"	0.52	100	204
	400	"	0.52	100	254

pH (1 + 5)/(1 + 5) 0.01 M $CaCl_2$

Rates of Molybdenum : in g Na_2MoO_4/ha

Results indicate

1. At this stage of plant growth, there are dry weight responses in the whole tops of wheat grown on the unpredicted soils of Wyalkatchem grey gritty sand and East Busselton mungite grey sandy loam as well as the predicted Pindar brown sand, Bodallin yellow sand, and Wongan Hills yellow sandy loam.

2. The Mo concentrations in the Y.E.B. of the wheat plants grown on the above soils without added Mo indicate an insufficient supply of Mo for maximum growth.

3. The Mo concentration in the Y.E.B. of the wheat plants grown on the Nil Mo Redmond peaty sand indicates an insufficient supply of Mo, but this is not reflected in the dry weights.

4. As the experiment continued through to maturity of the wheat, the East Busselton mungite grey sandy loam, the Wyalkatchem grey gritty sand, and the Wongan Hills yellow sandy loam grew out of their Mo deficiencies, probably from a build-up of an unknown source of Mo contamination.

There were additional problems of Na toxicity from the N source $NaNO_3$ which was regularly supplied, Ca deficiency in the West Binnu subsoil, and aphid attack.

2. LEACHING OF MOLYBDENUM

83GL2

Aim — To investigate if the leaching of the Molybdate ion exists in five acidic sandy soils

Location — Glasshouse B1 ; University of Western Australia.

The results of this experiment are as yet unavailable.