1985

Copper and zinc nutrition experimental results.

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COPPER AND ZINC NUTRITION

EXPERIMENTAL RESULTS

1985/86

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PLANT NUTRITION BRANCH

CONTENTS

SOUTH PERTH

ESPERANCE

1. LONG TERM COPPER TRIAL - NEWDEGATE RESEARCH STATION
66N14/2086 EX

1984 Block 2

Sown: June 2nd, Main plots
June 12th, Sub plots

Harvested: December 6th

Basals:

Superphosphate	150 kg/ha
Agran-34	55 kg/ha
Canna wheat	50 kg/ha

Table 1 The effect of applying various rates of copper in 1984 to areas that received copper in 1968 on wheat grain yield (t/ha)

$CuSO_4$ applied 1968 (kg/ha)	$CuSO_4$ Applied 1984 (kg/ha)			
	0	2.75	5.5	8.25
0	0.27	0.83	1.32	1.34
2.5	0.96	1.24	1.27	1.13
5.5	1.85	1.82	1.96	1.53
8.25	1.49	1.56	1.43	1.37
11.0	1.78	1.86	1.58	1.98
11.0 + 0.5 PA	1.56	1.62	1.45	1.50

Due to trial design, comparisons down columns are not strictly valid.

Table 2 The effect of applying various rates of copper in 1984 to areas that received copper in 1968 on the concentration of copper (ppm) in the YEB and grain of wheat

$CuSO_4$ applied 1968 (kg/ha)	$CuSO_4$ applied 1984 (kg/ha)							
	0		2.75		5.5		8.25	
	YEB	Grain	YEB	Grain	YEB	Grain	YEB	Grain
0	0.6	0.7	1.0	0.9	1.1	1.2	1.4	1.0
2.50	2.3	1.4	2.8	1.5	3.2	1.8	3.8	1.7
5.50	2.1	1.6	2.8	1.4	3.1	1.6	3.2	1.4
8.25	4.0	2.0	4.6	2.0	4.6	2.2	5.2	2.4
11.00	3.6	2.0	3.4	1.8	3.6	2.0	3.8	1.8
11.00 + 0.5 PA	3.6	1.8	3.6	1.8	4.0	2.0	3.8	1.8

1985 Results

Sown: July 6th, Main plots
July 9th, Sub plots

Harvested: December 12th

Basals:

Superphosphate	150 kg/ha
Urea	60 kg/ha
Aroona Wheat	45 kg/ha

Table 3 The effect of applying various rates of copper in 1985 to areas that received copper in 1969 on wheat grain yield (t/ha)

$CuSO_4$ applied 1969 (kg/ha)	$CuSO_4$ Applied 1985 (kg/ha)			
	0	2.75	5.5	8.25
0	0.21	0.56	0.61	0.67
2.5	0.59	0.60	0.64	0.57
5.5	0.71	0.70	0.70	0.65
8.25	0.70	0.70	0.66	0.58
11.0	0.81	0.73	0.77	0.71
11.0 + 0.5 PA	0.99	1.01	0.98	0.96

Due to trial design, comparisons down columns are not strictly valid.

2. COPPER, ZINC AND SULPHUR RESIDUAL WITH DAP FOR WHEAT
78WH66/ 2247 EX

Aim: To determine the decline in effectiveness of copper, zinc and sulphur on this soil using DAP.

Location: Wongan Hills Research Station

1984 Results

Sown: June 13th

Harvested: December 12th

Basals:

DAP	100 kg/ha
Super	200 kg/ha
Agran	53 kg/ha
Wheat (Gamenya)	50 kg/ha

Table 4 The effect of current and previous applications of copper, zinc and sulphur with different nitrogen-phosphorus sources on grain yield (t/ha) and concentrations of copper, zinc and sulphur in the grain

Treatment	NP Source	Grain Yield	Grain Concentrations S (%)	Cu (ppm)	Zn (ppm)
Cu + Zn	DAP	1.95	13	2.0	19
Cu + Zn + S (78)	DAP	1.88	12	1.9	18
Cu + Zn + S (81)	DAP	1.96	12	2.0	19
Cu + S	DAP	1.90	13	1.9	17
Cu + S + Zn (78)	DAP	1.86	14	2.1	20
Cu + S + Zn (81)	DAP	2.22	12	2.0	21
Cu + S + Zn (84)	DAP	1.96	11	2.4	23
Zn + S	DAP	1.84	12	1.8	21
Zn + S + Cu (78)	DAP	1.76	13	2.4	23
Zn + S + Cu (81)	DAP	2.16	13	1.6	24
Zn + S + Cu (84)	DAP	1.89	13	2.4	19
Nil	DAP	2.01	13	1.7	19
Cu (78)	DAP	2.09	13	2.0	17
Cu + Zn (78)	DAP	1.84	13	2.0	17
Nil	Super-Agran	2.09	13	1.8	19
Cu (78)	Super-Agran	1.92	13	2.1	18
Cu + Zn (78)	Super-Agran	1.85	14	2.3	22

Cu - 6.0 kg $CuSO_4$/ha
Zn - 1.0 kg ZnO/ha
S - 167 kg Gypsum/ha

3. COPPER AND ZINC RESIDUAL WITH DAP
78Mo36/2247 EX

Aim: To determine the decline in effectiveness of copper, and zinc on this soil.

Location: P. Shields - "Menardie", Dandaragan

Soil: Red Sandplain

1984 Results

Sown: June 27th

Harvested: December 11th

Basals: DAP 105 kg/ha
Wheat (Eradu) 50 kg/ha

Normally a sub-clover pasture trial, this was sown to wheat in 1984 in an attempt to clean up the large weed population.

Table 5 The effect of time of reapplication of copper and zinc on grain yield (t/ha), and concentrations of copper and zinc (ppm) in the YEB through time and in the grain of wheat

Treatment	Grain Yield	Copper concentrations			Zinc Concentrations		
		YEB T1	YEB T2	Grain	YEB T1	YEB T2	Grain
Nil	2.23	3.7	1.8	1.5	26	19	14
Cu (78)	2.15	5.1	2.8	2.0	25	17	13
Cu (79)	2.39	5.0	2.4	1.9	26	17	14
Cu (80)	2.07	4.7	2.2	1.7	26	19	13
Cu (83)	2.34	4.8	2.3	1.8	24	17	13
Zn (78)	2.08	3.0	1.5	1.2	27	20	14
Zn (80)	2.15	2.8	1.5	1.4	25	19	15
Zn (83)	2.13	3.2	1.8	1.4	27	18	14

T1 6 1/2 leaf stage; Feekes 6; Zadoks 16.5/24/31
T2 Boot stage; Feekes 10; Zadoks 18/33/48.

Cu 6.6 kg $CuSO_4$/ha topdressed in 60 kg Sand/ha
Zn 1.0 kg ZnO/ha topdressed in 60 kg Sand/ha

All plots received a basal dressing of 3.3 kg $CuSO_4$ and 2.0 kg ZnO/ha drilled in 1978.

4. ZINC RESIDUAL WITH HIGH ANALYSIS N.P. FERTILISER FOR WHEAT 80No31/2247 EX

Aim: To determine the decline in effectiveness of zinc on this soil using DAP for wheat.

Location: Wyalkatchem High School Block

1984 Results

Sown: June 21st

Harvested: November 29th

Basals:

DAP	125 kg/ha
Super-Agran	300 kg/ha
Gamenya Wheat	50 kg/ha

This trial site was accidently topdressed with superphosphate (zinc contaminated) in 1980. This trial, therefore, is being continually cropped to run down zinc levels before the residual aspect is continued.

Table 6 The effect of various fertiliser treatments on grain yield (t/ha), and concentrations of zinc (ppm) in the YEB and grain of wheat

Treatment in 1980	Grain Yield	Zinc concentrations YEB	Grain
DAP	1.36	36	27
DAP + Cu	1.29	40	24
DAP + Cu + Zn (0.75)	1.28	45	26
DAP + Cu + S	1.28	45	27
DAP + Cu + S + Zn (0.75)	1.32	39	29
DAP + Cu + S + Zn (1.5)	1.31	42	30
Super-Agran	1.12	47	28
Super-Agran + Cu	1.26	42	28
Super-Agran + Cu + Zn (0.75)	1.17	45	29

5. ZINC RESIDUAL WITH HIGH ANALYSIS N.P. FERTILISER FOR WHEAT
79Me22 & 79Me23/2247 EX

Aim: To determine the decline in effectiveness of zinc on this soil using DAP for wheat.

Location: Della Vedova, Narembeen

Soil: 79Me22 - Sand/gravel
79Me23 - Sand

1985 Results

Sown: June 13th

Harvested: November 25th

Basals:

DAP	104 kg/ha
DAP + Gypsum	258 kg/ha
Super-Agran	272 kg/ha
Wheat	47 kg/ha

Table 7 The effect of current and previous zinc applications with Nitrogen-Phosphorus fertiliser sources on grain yields (t/ha) of wheat for 79Me22 and 79Me23

Treatment	Grain Yields 79Me22	79Me23
DAP	0.51	1.30
DAP + Cu	0.47	0.94
DAP + Cu + Zn (0.75) - 1979	0.58	0.96
DAP + Cu + S	0.63	1.04
DAP + Cu + S + Zn (0.75) 1979	0.74	1.01
DAP + Cu + S + Zn (0.75) 1981	0.68	1.04
DAP + Cu + S + Zn (0.75) 1983	0.71	1.02
DAP + Cu + S + Zn (0.75) 1985	0.52	0.90
DAP + Cu + S + Zn (1.5) 1979	0.63	1.00
Super-Agran	0.54	1.22
Super-Agran + Cu	0.58	1.13
Super-Agran + Cu + Zn (0.75) 1979	0.78	1.18

Cu 6.00 kg $CuSO_4$/ha
Zn 1.00 kg ZnO/ha
S 167 kg Gypsum/ha

6. ZINC RESIDUAL WITH HIGH ANALYSIS N.P. FERTILISER FOR WHEAT
82Mo8/4035 EX

Aim: To measure the responses of cereals to zinc drilled with superphosphate or zinc applied as a soil spray on this site which produced zinc deficient plants in 1980.

Location: Crane - Gabalong

Soil: Grey clay loam
pH (water) 8.8

1984 Results

As each plot is the width of 3 cone seeder runs, 3 varieties of barley replaced wheat in each treatment this year.

Sown: June 1st

Harvested: December 6th

Basals: DAP 57 kg/ha drilled
BARLEY 50 kg/ha

Barley: Forrest
Stirling
Beecher

Table 8 The effect of zinc applications on the grain yield (t/ha) on the zinc concentration (ppm) and content (g/ha) of grain of three barley varieties

Barley Variety	Zinc Treatment	Grain Yield	Zinc Conc. Grain	Zinc Cont. Grain
Stirling	Nil	2.28	13	30
	ZnO (1)	2.28	15	34
	ZnO (2) '81	2.62	16	42
	ZnO (2) '83	2.50	14	35
	ZnO (4)	2.43	17	35
	ZnO (6)	2.19	19	42
	$ZnSO_4$ (3.5)	2.48	16	40
	$ZnSO_4$ (7)	2.40	16	38
	AV:	2.38		
Beecher	Nil	2.33	12	28
	ZnO (1)	2.24	13	29
	ZnO (2)	2.57	14	36
	ZnO (4)	2.28	17	39
	ZnO (6)	2.33	16	38
	$ZnSO_4$ (3.5)	2.40	15	36
	$ZnSO_4$ (7)	2.17	16	35
	AV:	2.33		
Forrest	Nil	1.90	13	25
	ZnO (1)	1.93	16	31
	ZnO (2)	2.04	16	33
	ZnO (4)	1.95	18	35
	ZnO (6)	1.71	18	31
	$ZnSO_4$ (3.5)	2.00	15	30
	$ZnSO_4$ (7)	1.95	16	31
	AV:	1.93		

Table 9 The effect of zinc applications on the dry weight of tops (t/ha), on the zinc concentration (ppm) and content (g/ha) of tops for three barley varieties at anthesis

Barley Variety	Zinc Treatment	Dry Weight Tops	Zinc Conc. Tops	Zinc Cont. Tops
Stirling	Nil	5.05	6.1	31
	ZnO (1)	4.88	7.4	36
	ZnO (6)	4.10	11	45
Beecher	Nil	4.76	5.4	26
	ZnO (1)	4.22	7.5	32
	ZnO (6)	3.87	8.3	32
Forrest	Nil	4.80	5.8	28
	ZnO (1)	5.83	8.0	47
	ZnO (6)	5.98	9.3	56

Table 10 The effect of zinc applications on the concentration of zinc in the YEB (ppm) through the growth of three varieties of barley

Treatment	Zinc Concentrations in YEB					
	T1			T2		
	Stir.	Beech.	Forr.	Stir.	Beech.	Forr.
Nil	17	16	15	17	17	15
ZnO (1) '81	20	19	21	19	19	17
ZnO (2) '81	24	22	25	20	20	18
ZnO (2) '83	20	-	-	20	-	-
ZnO (4) '81	28	20	27	21	22	19
ZnO (6) '81	32	23	29	21	21	20
$ZnSO_4$ (3.5) '81	26	24	25	19	20	17
$ZnSO_4$ (3.5) '81	24	23	22	20	20	19

T1 July 27th, 6 leaf stage, Feekes 5

T2 September 9th, Flowering; Feekes 12

7. ZINC, COPPER AND SULPHUR RESIDUAL WITH DAP
78LG27/2247 EX

Aim: To determine the decline in effectiveness of copper, zinc and sulphur on this soil using DAP

Location: G. Cugley, South Newdegate, Yellow Sandy Loam

Harvested: 9/12/85

Table 11 The effect of current and previous applications of copper, sulphur and zinc with different nitrogen-phosphorus sources on grain yield (kg/ha)

Treatment	Grain Yield
1. DAP + Cu + Zn	2129
2. DAP + Cu + Zn + S (1978)	2019
3. DAP + Cu + Zn + S (1982)	2000
4. DAP + Cu + Zn + S (1985)	2092
5. DAP + Cu + S	1981
6. DAP + Cu + S + Zn (1978)	1926
7. DAP + Cu + S + Zn (1982)	1963
8. DAP + Cu + S + Zn (1985)	2093
9. DAP + Cu + S	1963
10. DAP + Cu + S	2000
11. DAP + Zn + S	1685
12. DAP + Zn + S + Cu (1978)	2056
13. DAP + Zn + S + Cu (1982)	2018
14. DAP + Zu + S + Cu (1985)	2204
15. DAP + Zn + S	1944
16. DAP	1777
17. DAP + Cu (1978)	2093
18. DAP + Cu + Zn (1978)	1907
19. Super-Agran	1833
20. Super-Agran + Cu	2148
21. Super-Agran + Cu + Zn	2056

8. METHODS OF COPPER APPLICATION ON NEW LAND
85JE48/2247 EX

Aim: To examine the different methods of copper application on new land.

Location: Jerdacuttup, New land

Basals: P at 25 kg/ha; N at 30 kg/ha; Zn at 0.8 kg/ha, Mo at 120 g/ha

Table 11 The effects of copper application methods on the dry matter production (kg/ha), and grain yield (kg/ha) of wheat

Treatment	Dry Matter Production 19/8/85	7/10/85	Grain Yield
1. Nil Cu	1008	1514	1814
2. Nil Cu + Cu (EB)		1696	1929
3. Comm No. 1 drilled	1364	1685	1917
4. Comm No. drilled + Cu (EB)		1878	1950
5. Cu + Zn spray on soil	1421	1828	2197
6. TR5 + Cu (EB)		1773	2179
7. Comm No. 1 TD + Cultivate	1336	1796	2075
8. TR7 + Cu (EB)		1911	2220
9. Agras No. 2 TE	1396	1872	2005
10. TR9 + Cu (EB)		1860	2110
11. D of A dry mix No. 1	1270	1861	2098
12. TR11 + Cu (EB)		1906	2158

Cu (EB) = Copper Sulphate spray (1.0 kg/100 litres/ha) at early boot stage

9. EVALUATION OF COPPER ORE
85LG47

Aim: To evaluate Ravensthorpe copper ore as a copper source compared with copper sulphate when applied to new land

Sown: 21/6/85
Gutha wheat at 50 kg/ha

Soil: Yellow-sandy loam

Harvested: 11/12/85

Basal: Zn (0.7 kg/ha), Mo (75 kg/ha), P (18.5 kg/ha)

Table 12 The effect of copper from Ravensthorpe ore and sulphate on dry matter production (kg/ha) and grain yield (kg/ha)

	Dry matter 10/9/85	Grain Yield
Nil Cu	1408	655
Copper ore - 1/2 rate	1697	1127
Copper ore - full rate	1731	1713
Copper sulphate - 1/2 rate	1444	1428
Copper sulphate - full rate	1691	1597

Cu full rate = 2.64 kg Cu/ha

10. ZINC BY NITROGEN INTERACTION
85LG28

Aim: To measure the effects of DAP and high nitrogen rates on the severity of zinc deficiency of wheat grown on marginally zinc deficient soil.

Sown: 10/7/85
Aroona wheat at 50 kg/ha

Soil: Grey clay (Lake bank soil); Lake Camm.

Harvested: 5/12/85

Basals: P at 16 kg/ha
S at 19 kg/ha

Table 13 The effects of nitrogen rates and zinc on the dry matter production and grain yield of wheat

Treatment	Dry Matter Production 10/8/85	Grain Yield
1. Agrophos + Nil Zn	426	733
2. " + 0.5 ZnO	497	772
3. " + 1.0 ZnO	522	756
4. " + 2.0 ZnO	642	756
5. " + Nil Zn + Urea (32)	665	718
6. " + 0.5 ZnO + "	736	749
7. " + 1.0 ZnO + "	757	741
8. " + 2.0 ZnO + "	875	687
9. DAP + Nil Zn	635	725
10. " + 0.5 ZnO	690	795
11. " + 1.0 ZnO	716	718
12. " + 2.0 ZnO	818	772
13. " + Nil Zn + Urea (65)	762	494
14. " + 0.5 ZnO + "	833	648
15. " + 1.0 ZnO + "	887	687
16. " + 2.0 ZnO + "	902	656
17. " + Nil Zn + Urea (130)	777	448
18. " + 0.5 ZnO + "	992	694
19. " + 1.0 ZnO + "	1087	525
20. " + 2.0 ZnO + "	1068	578

11. ZINC RESIDUAL WITH DAP
85LG29/2247 EX

Aim: To define the residual effectiveness of zinc fertilizer on this soil type

Sown: 10/7/85
Gutha wheat 45 kg/ha

Location: R. Iffla, Lake Camm.
Lake Bank Soil type (grey clay)

Basals: P 24 kg/ha; N 21.6 kg/ha; S 30 kg/ha (TRS1-18);
Cu 1.5 kg/ha; Mo 80 g/ha

Harvested: 5/12/85

Table 14

Treatments	Grain Yields (kg/ha)
1. Nil Zn	578
2. ZnO (0.5)	672
3. ZnO (1.0)	718
4. ZnO (2.0)	752
5. Super-agran (S/A)	613
6. S/A + ZnO (1.0)	729

12. COPPER SULPHATE, COPPER CHELATE AND COPPER OXYCHLORIDE EFFECTIVENESS FOR WHEAT
85LG26/2247 EX

Aim: To determine the effectiveness of copper sulphate, copper chlate and copper oxychloride sprays for wheat grown on a copper deficient soil.

Sown: 21/6/85; North Lake Grace
Gutha wheat at 50 kg/ha
Yellow sandy loam

Basal: Zn (1.0 kg/ha); Mo (80 g/ha)

Harvested: 11/12/85

Table 15 The effects of rates of Cu spray from copper sulphate, copper chlate and copper oxychloride on grain yield (kg/ha)

Treatments	Grain Yield
1. Nil Cu Spray	370
2. $CuSO_4$ 100 g ha^{-1}, 6 leaf	771
3. " 200 " "	1141
4. " 400 " "	1657
5. " 800 " "	1882
6. " 1.6 kg/ha^{-1}, 6th leaf	1827
7. Cu Chelate 167 g ha^{-1}, 6th leaf	995
8. " 334 " "	1921
9. " 668 " "	1875
10. " 1.34 kg " "	1914
11. " 2.67 " "	1905
12. Cu Oxychloride 40 g ha^{-1}, 6th leaf	671
13. " 160 " "	864
14. " 320 " "	1627
15. " 640 " "	1799
16. " 1.28 kg/ha^{-1} "	1914
17. Cu drilled	1775

13. ZINC SULPHATE, ZINC CHELATE SPRAYS ON WHEAT
85LG27/2247 EX

Aim: To determine the effectiveness of zinc chelate sprays compared to zinc sulphate on this new land site.

Sown: 21/6/85
Gutha wheat at 50 kg/ha with DAP

Location: Lake Grace
Yellow sandy loam

Basals: Cu (1.5 kg/ha); Mo (80 g/ha); P (25 kg/ha); S (30 kg/ha)

Harvested: 11/12/85

Table 16 The effects of rates of zinc sprays at different times of application from zinc sulphate and zinc chelate sources on wheat grain yield (kg/ha)

Treatments	Grain Yield
1. Nil Zn spray	988
2. 220 g Zinc Sulphate ha^{-1}, 6 leaf stage	1019
3. 440 g " " " "	1049
4. 880 g " " " "	1151
5. 1.76 kg " " " "	1165
6. 167 g Zinc Chelate ha^{-1} "	989
7. 334 g " " " "	1081
8. 668 g " " " "	1203
9. 1.336 kg Zinc Chelate ha^{-1}, "	1313
10. 2.627 kg " " " "	1320
11. 220 g Zinc Sulphate ha^{-1}, early boot	1026
12. 440 g " " " "	1181
13. 880 g " " " "	1243
14. 1.76 kg " " " "	1204
15. 167 g Zinc Chelate ha^{-1} "	965
16. 334 g " " "	1012
17. 668 g " " "	1118
18. 1.336 kg Zinc Chelate ha^{-1}, early boot	1220
19. 2.672 kg " " " "	1112
20. Zn drilled	1752