1975

1975 Mn drilled and sprayed on Unicrop

J. W. Gartrell

J.W. CARTRELL

75AL25/3074EX
(With Trevenen)

Mn Drilled and Sprayed on Unicrop

R. LALLY, KENDENUP - 1975

Area harvested 80 m x 1.91 (Plot yields in kg)

Treatment						Mean kg/ha
1.	MnO					1 276
2.	Mn 15	drilled				1 296
3.	22.5					1 348
4.	30					1 213
5.	45					1 311
6.	4	spray 6	wks	after	germination	1 150
7.	8	"	"	"	"	1 326
8.	12	"	"	"	"	1 366
9.	16	"	"	"	"	1 267

Soil type: 45 cm white sand over gravelly clay
Moiet-white gum.

History: Cleared 1963 with 200 kg/ha CuZnA + clover.
1964-67 - 200 kg/ha super/yr. 130 kg/ha/yr after aut.
1974 - first crop barley with 200 kg/ha CuZn B yielded 2.2 tonne/ha.

Sown 16.5.75 - Lupin gum slurry inoculated and sown at 96 kg/ha.

Super 300 kg/ha basal.

No significant increase in grain yield due to Mn treatments. There was no sign of split seed in this trial and no relationship between the small amount of shrivelled seed and treatment.

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75AL 26/3074EX

Mn Drilled and Sprayed on Unicrop

D. BUSSELL, GREEN RANGE - 1975

Soil: Grey sand/clay. Mallee and chittick. Cleared 66/67. CuZn in 1967.

Total super approx. 2 470 kg/ha. Pasture '72, '73 - Rape in '74.

Basal: Unicrop gum slurry inoculated, sown @ 96 kg/ha 14.5.75. Super 300 kg/ha drilled.

Spray treatments applied 7.7.75 on fine still day - p.m. 1 l/ha DDT 25% on 15.5.75.

Treatments	Grain t/ha	% of seed in harvested sample				
		Dehulled	Whole Entire	Whole Split	Shrivelled Entire	Shrivelled Split
1. Mn 0	1.01	1.7	62.2	15.8	16.8	3.5
2. $MnSO_4$ 15 kg/ha drilled	1.37	1.0	95.5	0.4	2.9	0.1
3. " 22.5 " "	1.49	1.1	92.4	0.9	5.1	0.4
4. " 30 " "	1.55	1.6	93.2	1.0	4.3	0.0
5. " 45 " "	1.49	1.1	95.6	0.0	3.3	0.0
6. $MnSO_4$ 5.3kg/ha sprayed 6 weeks after germ.	1.37	1.6	82.4	11.7	6.8	0.2
7. $MnSO_4$ 10.6 kg/ha sprayed 6 weeks after germ.	1.27	3.1	85.7	4.0	6.4	0.7
8. $MnSO_4$ 159 kg/ha sprayed 6 weeks after germ.	1.25	0.8	95.5	1.5	1.7	0.6
9. $MnSO_4$ 21.2kg/ha sprayed 6 weeks after germ.	1.42	2.8	91.5	0.7	5.0	0.0

3 reps, plots 60 m long x 2.1 m.

Mn sprayed or drilled increased grain yield by 30%. The lowest rate sprayed or drilled appeared sufficient for maximum yield. 15 kg/ha Mn SO_4 drilled eliminated split seededness and increased the amount of whole entire seed in the sample from 62% to 96%.

Significant quantities of damaged seed occurred in the two lowest levels of spray application. In this trial 12 kg/ha sprayed was needed to reduce damaged seed to below 10%. In all other trials so far conducted along the south coast, rates around 4 kg/ha sprayed have adequately controlled split seed and given maximum yields.

This trial is significant for that reason.

In the adjoining farmer's crop split seed was bad. This is not unexpected because he topdressed only 15 kg/ha and topdressed manganese sulphate has been shown to be only about half as effective as when drilled with the super and seed.

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75TS25/3074EX
(with Herbert)

Rates of Mn Drilled on Unicrop

R. MORGAN - WEST THREE SPRINGS

Area harvested - 80 x 1.78 m - Yields in kg
(4 reps)

Treatments	Mean kg/ha
1. $MnSO_4$ 0	355
2. 15 kg/ha	411
3. 22.5 "	335
4. 30 "	284
5. 45 "	344
6. 60 "	211

Soil: Grey sand/white sandy gravel @ 30 cm.

History: Cleared and first crop 1968 200 kg/ha Cu Zn Mo super.
1969 - Crop with 200 kg/ha super;
1970 - nil; 1971 - crop 200 super;
1972 - Seeded to clover 100 kg/ha super;
1973 - Pasture 100 T.D.
1974 - Pasture 200 kg/ha T.D.
1975 - 200 kg/ha super T.D. by farmer before trial was planted.

Basal: Unicrop, not inoculated @ 95 kg/ha - sown 21.5.75.

Super: 197 kg/ha T.D. before seeding.

Due to a mix up of mixtures in the drill, varying rates of super were drilled with the Mn rates shown to get the right Mn rates. As there was no response to treatments and yields were very low, the need to consider the possibility of confounded variables was avoided.

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75TS24/3074EX
(With Herbert)

H. McNEIL, ENEABBA - 1975

Rates of Mn Drilled on Unicrop

Area harvested: 80 x 1.78 m - Yields in kg - (4 reps)

	Treatments	Mean t/ha
1.	$MnSO_4$ 0	1.01
2.	15 kg/ha	1.57
3.	22.5 "	1.65
4.	30 "	1.69
5.	45 "	1.75
6.	60 "	1.72

Soil: Grey sand/pale yellow sand/gravel.
New land - scrubplain.

Basal: Unicrop uninoculated sown @ 95 kg/ha on 26.5.75.

Super 197 kg/ha T.D. before seeding + 197 kg/ha drilled with seed.

There was a marked yield increase with the first 15 kg/ha $MnSO_4$, with a trend towards further increases up to the 45 kg/ha level. In this trial no rate of manganese sulphate was deleterious. In some previous trials there have been seedling deaths with rates over 40 kg/ha.

Data on split seededness are not available but it was reported that the 30 kg/ha treatment produced a harvester sample which contained only low levels of split seed.

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75M031/3074EX (With Fievez, Frankish, Lester)

Mn Rates Drilled and Sprayed on Unicrop

I. GRIFFITHS, GILLINGARRA

60 x 1.78 m Yields in kg

	Treatments				I	IV	III	Total	Mean kg/ha
	Co Sulphate	$MnSO_4$D	$MnSO_4$	Sprayed					
1.	0	32			15.2	21.4	21.0	57.6	1798
2.	0.5	0			15.6	19.6	20.3	55.5	1732
3.	"	16			12.6	18.9	21.4	52.9	1651
4.	"	32			17.2	19.4	19.4	56.0	1748
5.	"	48			13.8	19.8	19.6	53.2	1660
6.	"	0	4	6 wks	14.1	18.3	20.9	53.3	1664
7.	"	"	8	"	13.5	17.5	18.0	49.0	1529
8.	"	"	12	"	14.6	15.6	19.5	49.7	1551
9.	"	"	16	"	13.5	19.7	20.9	54.1	1689
10.	"	"	4	10 wks	13.2	15.2	19.6	48.0	1498
11.	"	"	8	"	14.9	22.8	19.1	56.8	1773
12.	"	"	12	"	13.8	20.8	18.9	53.5	1670
13.	"	"	16	"	12.5	19.3	19.7	51.5	1607
14.	"	"	4	Mid Fl.	14.6	19.0	20.2	53.8	1679
15.	"	"	8	"	14.3	15.2	20.5	50.0	1561
16.	"	"	12	"	14.2	20.4	20.3	54.9	1713
17.	"	"	16	"	15.1	21.1	19.3	55.5	1732

Soil type: 15-30 cm grey-brown gravelly sand/brown gravelly loamy sand.

Seeding date (Mid May?) Old land?

Seed gum slurry inoculated and sown @ 100 kg/ha.

Basal super 300 kg/ha drilled.

There was no grain yield increase to any of the manganese treatments.

Grain samples from these trials are yet to be examined for split seededness but the preliminary report is that splitting was negligible.

When inspected in October, I found some leaf manganese deficiency symptoms in a sandy valley down slope from the trial, whereas the trial looked perfectly healthy and the seed which was quite advanced had not split.

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75GE32/2993EX

(With Ewing, Highman, Chatel)

Inoculation - Co, Mn, K & B on Unicrop

I.R. & R.H. HARRISON, ALLANOOKA - 1975

Soil: Grey sand/pale yellow sand/gravel @ 60 cm.

Area harvested = 60 x 1.22 m.

	Treatments					I	II	III	IV	Total	Mean kg/ha
	Inoc	Co	Mn	K	B						
1.	-	0	30			5.4	5.9	6.3	6.8	24.4	833
2.	+	0	30			5.0	6.3	5.7	6.3	23.3	796
3.	-	0.5	30			4.8	4.5	5.7	6.3	21.3	717
4.	+	0.5	30			5.4	5.0	5.4	5.0	20.8	710
5.	+	0.5	0			5.9	5.4	6.6	5.9	23.8	813
6.	+	0.5	15			5.0	6.3	5.9	6.3	23.5	803
*7.	+	0.5	30	100		3.2	4.1	3.2	3.6	14.1	482
*8.	+	0.5	30	100	5	2.3	4.1	3.2	4.8	14.4	492

Potash was drilled mixed with super with the seed and greatly reduced seedling survival which is reflected in the lower treatment yields.

No other treatment differences occurred.

Two other Mn trials on lupins, 75MO32 and 75TS26 were washouts.

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75ES28/3074EX

Inoculation, Co, Mn on Unicrop Lupins

P.C. WALKER, WILGA

No	Inoc	Co	Mn Drilled	Agral	Mn Sprayed @ 8 weeks	Mn Sprayed at pod formation	I	II	III	Total	Mean t/ha
1	-	0	15				11.4	11.7	12.1	35.2	1.10
2	-	+	15				10.4	11.0	10.1	31.5	0.98
3	+	0	15				16.9	12.7	13.0	42.6	1.33
4	+	+	15				15.4	15.0	15.9	46.3	1.45
5	+	+	0				13.5	14.0	14.6	42.1	1.32
6	+	+	0				14.0	14.9	14.2	43.1	1.35
7	+	+	30				16.3	15.1	14.5	45.9	1.43
8	+	+		+	0		16.2	MP	14.4	(30.6)	1.28
9	+	+		+	6		16.7	15.2	16.4	48.3	1.51
10	+	+		+		6	14.8	15.1	13.6	43.5	1.36
11	+	+			6		14.4	13.7	12.6	40.7	1.27
12	+	+			10.5		15.5	17.8	15.4	48.7	1.52
13	+	+			15		15.4	15.6	13.9	44.9	1.40
14	+	+				6	15.7	14.0	16.7	46.4	1.45
15	+	+				10.5	15.0	13.6	MP	(28.6)	1.34
16	+	+				15	15.9	15.6	14.3	45.8	1.43

Inoc = gum slurry inoculated Co + = Co sulphate @ 420 g/ha

Mn drilled = Mn sulphate drilled with seed and super (kg/ha)

Mn sprayed = Mn sulphate sprayed with 100 l/ha at 8 weeks after germination and at early pod formation

Agral = agral 60 sprayed @ 625 mls in 100 l/ha with or without an Mn spray

Soil : 15 to 30 cm grey sand over pale yellow sand/gravelley sand @ 70 cm. New land.

Basal : 370 kg/ha super across plots with Cu and Zn + 300 kg/ha Drilled with seed. Unicrop @ 100 kg/ha sown 30-4-75.

1st spray on 21-7-75. 2nd spray on 9-9-75.

DDT applied 7-5-75 and 13-6-75 @ 0.4 kg/ha of 25% DDT.

Comments: Large response to inoculation. Co had no effect, probably due to high Co seed level compared with 1974. No effect of Mn on yields. Slight degree of split seededness in harvester sample with 2 to 4% with no Mn. Mn treatment almost eliminated this split seed.

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Cobalt x Inoculation Trials

These trials, which were carried out in partnership with D. Chatel, are shown in his report.

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74M033/3074EX

Rates of Sprayed and Drilled $MnSO_4$ on lupins in 1974 recropped in 1975 with one rate of $MnSO_4$ applied to selected treatments

Residual Test 1975

K. WILLIAMS, LANCELIN

$MnSO_4$ kg/ha treatments				Grain kg/ha	Mn (ppm) in tops				Seed				Mn ppm in soil October 1975			
	Dr.	Spr.	Dr.	Yield	Lupins	Turnip	Other Herbs	Grass	Norm	Norm. Split	Shrivelled	Shriv Split	Total	NH_4AC	EDTA	H.Q.
1	0	0	0	95	22.0	17.5	39.5	N.S.	84.7	7.4	7.6	0.2	9.1	0.8	1.1	0.5
9	0	6	0	156	25.3	27.0	51.7	96.0	94.5	3.2	2.3	0.0	9.0	1.7	1.9	1.0
14	0	8	0	119	34.0	30.3	69.0	N.S.	93.1	2.8	4.1	0.0				
2	15	0	0	107	26.0	24.7	40.3	110.0	91.9	2.1	5.4	0.7	9.5	2.2	3.0	1.4
6	0	4	15	222	63.0	42.3	82.0	100.0	96.0	1.2	2.8	0.0				
7	15	4	0	95	38.3	28.7	36.7	69.0	96.3	0.0	3.7	0.0				
3	22.5	0	0	95	36.3	30.7	52.0	N.S.	93.9	1.1	5.0	0.0	9.1	3.4	4.2	1.4
15	15	8	0	148	47.0	35.3	59.7	110	96.5	0.2	3.3	0.0				
17	0	8	15	126	73.3	58.0	83.3	90.5	97.9	0.0	2.1	0.0				
18	15	8	0	126	46.7	36.7	79.3	80.7	91.9	0.0	8.1	0.0				
11	22.5	6	0	164	47.0	38.7	63.0	86.5	97.8	0.1	2.1	0.0	13.7	4.5	6.1	2.8
8	30	4	0	180					95.7	0.0	4.3	0.0				
10	15	6	15	170	58.3	58.0	77.3	100.0	95.6	0.0	4.4	0.0	10.7	3.8	5.5	2.2
12	30	6	0	161	50.5	39.7	71.0	72.0	93.6	0.0	6.3	0.1	13.0	4.6	6.8	3.6
16	30	8	0	130					93.8	0.0	6.2	0.0	13.0	4.5	6.4	3.4
19	30	8	0	175					93.3	0.3	6.4	0.0				
4	30	0	15	162	80.7	49.3	64.3	86.5	96.8	0.0	3.2	0.0	11.8	4.4	5.7	3.6
5	45	0	0	175	45.0	37.0	63.3		96.9	0.5	2.7	0.0	13.3	4.7	6.5	3.5
13	45	6	0	144	60.3	45.7	84.0	84.5	91.0	0.2	8.8	0.0	14.3	6.1	8.5	4.3
				Hand harvested	Sampled 10-7-75								Surface 0-15 cm			

N.S. = no sample. Dr. = drilled. Spr. = sprayed

H.Q. = Hydro Quinone

Soil : Yellow sand. 1st crop on new land in 1974.

In 1975 the trial was scarified along the direction of the plots the day before seeding. A heavy subsequent germination of weeds, mainly wild turnip, almost swamped the lupins which were also

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thinned out or weakened by root or collar rot. Surviving lupin plants were sparse and spindly. Final grain yields were very low but there appears to be an increase due to Mn application.

The data showed that 1974 Mn applications did have a definite residual effect. Mn drilled in 1975 was about 25% as effective in increasing Mn concentration in the plant as a 1975 drilled application. Mn sprayed in 1974 was surprisingly very much more effective than the 1974 drilled application. The 1974 sprayed Mn was 67% as effective as the 1975 drilled Mn.

Although these differences in availability were apparent in the plant tissue data, analysis of soil samples taken in October 1975 failed to reveal any differences between 1974 sprayed or 1974 or 1975 drilled Mn in levels which were recoverable by different extractants. However the residual effect of applied Mn on extractable Mn was large.

This is an example of how simple soil analyses do not necessarily accurately reflect the ability of the plant to absorb the particular element.

The possibility of Mn applications retaining substantial residual effectiveness on these soils considerably increases the chances of economically eliminating split seededness from lupin crops on severely affected soils.

Probably because the lupins were so poorly grown there was only a relatively low incidence of split seed. The effect of Mn applications in eliminating split seed was obvious (compare with results in last year's report).

The Mn concentration in lupin and wild turnip plants was generally remarkably similar except where, as one would expect, the Mn drilled in 1975 with the seed, gave the lupins higher Mn levels than the turnip. The Mn levels in the other herbs generally tended to be higher than in the lupins or turnip. It was interesting that the Mn levels in grass were high relative to lupins or turnip regardless of Mn treatment. This may or may not have some significance with regard to the absence of Mn deficiency of cereal crops grown on these same soils.

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Copper Nutrition of Wheat

1. Newdegate Long Term (28 years) Copper Trial

a) Wheat : Block 1 was cropped to wheat in 1975 in accordance with the rotation 1 year wheat : 3 years clover pasture. Copper was originally applied to Block 1 in 1967. Within each 2.03 ha plot of Block 1 a small trial (4 treatments, 2 reps) was laid down to determine the response to 1975 dressings of copper. Results are shown in Table 1.

Table 1 : Effects of 1975 applications of copper fertilizers on wheat grain yield on areas which had different rates of copper fertilizer in 1967. (66N14 Long Term Copper Trial, Newdegate Research Station).

Copper sulphate kg/ha applied 1967	Wheat yields in t/ha Copper sulphate (kg/ha) applied 1975			
	0	2.75	5.50	8.25
0	0.1	0.8	1.1	1.1
2.75	1.3	1.3	1.3	1.3
5.50	1.2	1.1	1.2	1.2
8.25	1.2	1.1	1.1	1.1
11.00	1.2	1.1	1.3	1.1
11.00 plus 0.55 each year since	0.7	0.8	0.9	0.7

Clearly there was only a response to a 1975 copper application where no copper was applied in 1967.

Table 2 shows the initial response to copper on all blocks. A feature of the initial response is the trend towards continuing small yield increments up to the highest rate used, 11.0 kg/ha copper sulphate, whereas only 2.75 kg/ha of that same 1967 application appeared fully adequate in 1975, eight years later.

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Table 2: Effects of rates of copper sulphate mixed with superphosphate and drilled with the seed on wheat grain yield where no copper had been previously applied.

Copper sulphate kg/ha applied to 1st crop on new land	Wheat yields t/ha					
	Block 1 1967	Block 2 1968	Block 3 1969	Block 4 1970	Mean	Fitted Mean
0	0.3	0.0	0.3	0.4	0.2	0.10
2.75	0.7	0.3	0.8	1.1	0.7	0.70
5.50	0.6	0.4	0.8	1.2	0.7	0.81
8.25	0.6	0.7	0.7	1.2	0.8	0.87
11.00	0.8	0.8	0.9	1.5	1.0	0.92
11.00	0.6	0.8	0.9	1.4	0.9	0.92

Table 3 shows the response to copper applied four years after applications of various rates. The response is similar to that obtained in 1975 on Block 1 eight years after the initial treatments.

Table 3: Effects of applications of copper on wheat grain yield four years after applications of various initial rates.

Copper sulphate kg/ha applied to initial crop	Copper sulphate kg/ha applied four years after initial treatment															
	0			2.75			5.50			8.25			Mean of 3 Blocks			
	2	3	4	2	3	4	2	3	4	2	3	4	0	2.75	5.50	8.25
0	0.1	0.2	1.0	0.6	0.6	1.6	0.9	0.5	1.8	1.2	0.6	1.6	0.4	0.9	1.1	1.1
2.75	0.9	0.6	1.5	1.1	0.8	1.4	1.1	0.6	1.3	1.1	0.7	1.5	1.0	1.1	1.0	1.1
5.50	1.6	0.6	1.6	1.8	0.7	1.8	1.8	0.6	1.6	1.8	0.6	1.6	1.3	1.4	1.3	1.3
8.25	1.0	1.1	1.5	1.0	1.1	1.5	1.0	1.0	1.5	1.0	1.0	1.6	1.2	1.2	1.2	1.2
11.00	1.7	1.1	1.7	1.7	1.0	1.8	1.8	1.2	1.7	1.7	1.1	1.6	1.5	1.5	1.6	1.5
11.00 + 0.55/yr	1.8	0.9	1.6	1.9	0.9	1.8	1.8	0.8	1.6	1.8	0.8	1.4	1.4	1.5	1.4	1.3

2 = Block 2 in 1972 (Block 1 wheat crop was destroyed by hail in 1971)

3 = Block 3 in 1973 (Block 3 wheat crop was badly damaged by hail in 1973)

4 = Block 4 in 1974

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b) Pasture and Sheep: Pasture was sampled for yield and copper content. Yield figures showed there was only a very small response to applied copper and the 2.75 kg/ha copper sulphate rate was enough for maximum yield. Chemical analyses of 1975 samples are not yet complete.

No effect of copper treatment on sheep liveweight change was detected.

Some secondary crimp formation was detected throughout all treatments, but tending to be worst in sheep longest on nil plots. None of the black wooled sheep showed any sign of banding this year. Thus signs of copper deficiency were confined to only a small proportion of the sheep that had been on the plots for from 12 to 30 months.

Wheat has proven to be more seriously affected by low copper supply than pasture or sheep in this trial.

2. Copper for Wheat on New Land

In the last few season there had been a distrubing number of reports from Lake Grace district farmers who claimed to have used the recommended copper fertilizer mix at the recommended rate on new land on crops which subsequently failed due to copper deficiency. Because our recommendations are based on a very large number of experiments, many of which have been situated on some of the most severely copper deficient soils, we have been puzzled by these failures.

On a new land site next to a crop which failed in 1974, an experiment was set up as a check on our recommendations. In addition to various mixtures of super, copper sulphate, zinc oxide and molybdenum oxide, which we mixed ourselves, we also included one commercial super copper zinc molybdenum mixture for comparison. The results are shown in table 4. The commercial mixture proved much less effective than our own mixture that gave the same trace element applications that the commercial mix should have done if it contained its claimed constituents. Analysis of a sample of the commercial mixture subsequently showed that it only contained 67% of the copper it should have had. However, even allowing for this lower copper content the commercial mixture was less effective than our own low analysis mixtures suggesting that the copper in the commercial mixtures was less available than that in our own mixtures.

Possible reasons for this are (1) that the fertilizer company had switched to using a "cupric oxide" instead of copper sulphate. This Department had earlier shown that because cupric oxides were only about half as effective as copper sulphate, about twice as much cupric oxide had to be used to eliminate copper deficiency on wheat on new land. However, further work showed that when cupric oxide is wet mixed as in the granulation process, its copper is just as soluble as wet mixed copper sulphate. It seems that the second possibility may be more important.

(2) that granulation of copperised super reduces the opportunity for plant roots to intersect regions of high copper concentration.

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Another trial (see table 5) was situated on an area which produced a crop which failed in 1974 due to copper deficiency despite the farmer's claims to have used the recommended rate of a commercial copper mixture. In this trial, wheat showed a yield response to an additional 3 kg/ha copper sulphate drilled with the 1975 crop which contrasts with the response pattern obtained in the Long Term Copper Trial on Newdegate Research Station and suggests that something less than the equivalent 2.75 kg/ha copper sulphate had been applied to the area in 1974 compared with the recommended 6 kg/ha copper sulphate. Analysis of soil samples from within rows and between rows of the 1974 crop and of residues from a bulk fertilizer dump were consistent with the results of the experiment.

Other trials at Salmon Gums (table 7), Jerdacuttup and Wittenoom Hills produced results in line with our previous findings.

Table 4: Effects of copper fertilizer on wheat grain yield on new land next to a crop which failed due to copper deficiency in 1974 although the farmer claimed to have used the rates of fertilizer recommended by this Department. (75LG25, G. Lee, Newdegate.)

Copper* kg/ha	Zinc Oxide kg/ha	Molybdenum Oxide g/ha	Description of mix	Wheat Yield t/ha	Wheat Yield As % of highest	Cu ppm in youngest fully emerged leaf Sept. 1975
1. 0	0	0	Plain super	0.79	45	0.94
2. 0.5 as a 2% spray	0	0		1.56	90	2.1
3. 0.83 drilled	0	0	Copper super	1.71	98	2.3
4. 0.83 "	1	180	our No. 2	1.22	70	1.1
5. 1.67 "	0	0		1.72	99	Destroyed
6. 1.67 "	0	180		1.65	95	2.3
7. +1.67 "	1	180	our No. 1	1.66	95	1.5
8. +1.67 "	1	180	Commercial No. 1	1.03	60	1.1
9. 1.67 "	2	0	our Mix A	1.34	77	1.3
10. 1.67 "	2	180		1.33	77	1.5
11. 1.67 drilled + 0.55 sprayed	1	180		1.74	100	1.9

* Copper as copper sulphate in all treatments except in treatment 8 where the nature of the copper in the commercial mix was unknown.

\+ Recommended fertilizer for first wheat crop after clearing this soil type is 250 kg/ha super copper zinc No. 1 where it contains the trace elements as shown for our mixture.

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Table 5: Effects of copper fertilizers on wheat grown on an area on which wheat failed due to copper deficiency in 1974 although the farmer claimed to have used the rates of fertilizer recommended by this Department. (75LG24, G. Lee, Newdegate.)

Copper sulphate kg/ha	Wheat yield t/ha	Wheat yield as % of highest
0	1.40	89
1.5	1.47	93
3.0	1.56	99
6.0	1.55	98
9.0	1.58	100
6.0 + molybdenum	1.58	100

3. Use of tissue test for copper under field conditions

Analysis of the youngest fully emerged wheat leaf was carried out on samples from a number of situations where there was some need to assess the copper status of the wheat plants. Where there were other means of assessing this the performance of the tissue test could be gauged. Crop stage varied from mid tillering to post anthesis. Details are shown in table 6 (see also table 4).

Based on previous work carried out mainly be the W.A. and Murdoch Universities' people the critical level for this test is just over 1 ppm Cu.

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Table 6: Copper content of youngest fully emerged leaves of wheat for diagnosis.

Source of material	Description	Cu ppm	Remarks
Porter, Wittenoom Hills Wheat Reddish clomed clay, no previous Cu applied. Soil type is recognised as being severely Cu deficient in absence of Cu fertilizer.	Severe symptoms No symptoms	0.7 1.8	Plants were showing extreme flaccidity similar to those of manganese deficiency. Esperance advisers suspected Cu deficiency. The tissue test confirmed the visual diagnosis. A 2 kg/ha copper sulphate application was recommended and applied with a dramatic recovery resulting except where the spray missed.
Henderson, Scadden Eagle Wheat Dampier barley Same soil type and history as above.	Severe symptoms Slight tipping	0.5 1.1	Wheat was showing vegetative symptoms as above. Barley showed no vegetative symptoms. As the ears emerged the wheat showed typical Cu deficiency symptoms while the barley showed only occasional tipping. Wheat and barley were sown under identical conditions in the same paddock on the same day. A 2 kg/ha copper sulphate spray was applied but most of the wheat had flowered and the spray was too late to allow full recovery.
Creagh, W. Dandaragan Wheat Grey gravelly sand over brown gravelly earthy sand. 210 kg/ha Super Cu ZnA in 1965. 120 kg/ha Cu super in 1971. For this soil single application of 220 kg/ha A mix is recommended.	Tipping of ears	3.0	Extremely well grown wheat plants had produced severely tipped ears. The combined effects of root rot and a dry spell were suspected, but the farmer wondered about Cu deficiency. Tissue test showed relatively high copper level consistent with wheat is considered to be a higher than necessary Cu fertilizer history.
Roberts & Son, Goomalling Pale brown loamy sand. Wheat No previous copper history. This is dissected sand plain country with only a few remnants of typical intact laterite plateau country. The dissected slopes are suspected to be marginally copper deficient where they consist of highly weathered material.	Wheat showed some tipping of flag leaves which had gone brown	1.1	The tipping of the flag leaves in the late boot stage was not clearly typical of copper deficiency as the material had gone brown - more like effects of drought. However the possibility of marginal copper deficiency on this country with no Cu fertilizer history was high. Inspection of the crop in the field at about anthesis revealed small patches in which typical ear symptoms of Cu deficiency were found which suggests that this was a case of marginal copper deficiency as indicated by the analysis.

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Table 6 cont/d...

Source of material	Description	Cu ppm	Remarks
East Ravensthorpe Wheat	Good crop Poor crop	3.0 3.6	Wheat samples showed severe nitrogen deficiency and slight phosphorus deficiency, but farmer and adviser were not happy with that diagnosis suspecting that an earlier contractor-applied trace element fertilizer dressing had been inadequate. Tissue test indicated that copper was not limiting.
Corke, Yealering Corke's neighbour	No symptoms Severe symptoms Healthy	0.7 0.3	Wheat samples were showing flaccidity which the farmer thought was Mn deficiency but which Robson suspected to be Cu deficiency. Analyses strongly suggest Cu deficiency as Mn levels were quite normal.
Oosterhouse Reichstein } E.Scaddan Healthy wheat crops where adviser was interested in getting some idea of their Cu status. New land.	Healthy Healthy	3.2 3.5	Copper sulphate spray treatments on these gave no yield response. These came from a crop on Circle Valley sand grown without Cu fertilizer. Cu fertilizer is not usually needed on this type.
Mt. Madden New land.	Symptoms No symptoms	0.8 1.3	Cu deficiency suspected by adviser although farmer had applied recommended rate of correct commercial mix. Healthy plants came from the headlands.
Evans, Dandaragan red earthy sand o previous Cu	Severe symptoms No symptoms	0.6 0.8	Very floppy wheat growth was diagnosed by some as Mn deficiency which would not be expected on this soil type. This soil is known to be usually very Cu deficient. Analysis is consistent with plants being Cu deficient. At maturity empty ears were general in plants that earlier appeared healthy.
Pearce, Salmon Gums 75ES29 Yellow earthy sand Broombush sandplain	No symptoms	2.9	From the nil treatment of a rates of Cu trial in which there was no response to Cu.

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The experience with the tissue test, summarised in Table 6, is consistent with the early indications obtained by University workers that this test was a good indicator of copper status of wheat during the vegetative phase.

Table 7

75ES29/2247EX

Cu Zn Mo in Wheat

C.E. PEARCE, SALMON GUMS - 1975

Soils : Pale yellow earthy sand carrying broombush.

History: 1st crop 1965, plain super 70 kg/ha - left and recropped;

1970 - with 130 kg/ha plain super - left until 1975.

Basal : 250 kg/ha super + 178 kg/ha ammonium sulphate. Madden wheat at 50 kg/ha.

Reps 4 - Plots 60 x 1.78m (harvested)

Treatment	Grain t/ha
1. Roasted molybdenite 140 g/ha	1.46
2. " " 140 " + $CuSO_4$ 2.75	1.28
3. " " 140 " + " 2.75 + ZnO 0.825	1.54
4. " " 140 " + " 5.5 + " 1.65	1.35
5. " " 140 " + " 8.25 + " 3.3	1.32
6. " " Nil " + " 2.75 + " 0.825	1.45
7. Plain super	1.51

No response to Cu, Zn or Mo.

Occasional responses to copper have been observed on this soil type which is also suspected to be marginal for zinc for oats and sub clover. An application of 250 kg/ha super Cu Zn B mix is recommended for this soil type.