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DEPARTMENT OF AGRICULTURE, W.A.

PLANT RESEARCH DIVISION

1969 RESULTS OF FIELD EXPERIMENTS

J.W. Gartrell

WHEATBELT TRACE ELEMENT NUTRITION 1969

1. Rates of Copper and Zinc on Wheat.

1. 69LG4/2247EX - W. Haggety, Sth Mt Madden.

Soil Type: Yellow earthy sand with gravel at shallow depth in Ms 8 soil association (not as mapped in Sheet 5 of Atlas).

Original Vegetation: - Not recorded.

History: Not recorded (New land 1st crop), sown 27/5/69.

Variety: Falcon wheat. Basal MoO_3 2 oz/ac, Urea 50 lb/ac, P & S equivalent to 180 lb/ac superphosphate.

Results: Effects of combinations of copper and zinc and high super.

Zinc Oxide lb/ac	Bu/ac			
	0	Bluestone 2½ lb/ac	5 lb/ac	7½
0	14.3	22.3	21.2	21.2
¾	7.0	19.5	22.0	22.4
1½	4.7	17.1	21.2	20.4
3	5.0	14.6	18.4	21.1

Plain super (Nil Mo) = 15.4 Super 250, Mo Cu 5, Zn ¾ = 25.0
Aerophos + gypsum = 7.8

Copper, zinc, molybdenum superphosphate No. 1 mix is the current recommendation for this soil to apply bluestone 5 lb/ac & zinc oxide ¾ lb/ac. Such an application would be satisfactory. It should be noted that the yield with 250 lb/ac super was 3 bu/ac higher than with 180 lb/ac.

Zinc appeared to depress yield in all combinations with nil and 2½ lb/ac bluestone and where more than 1½ lb/ac zinc oxide was applied with 5 lb/ac bluestone.

2. 69LG7/2247EX - I. Chamberlain, Nth Newdegate.

Soil Type: Yellow sandy earth with gravel at shallow depth in soil association Ms 8.

Original Vegetation: Not recorded.

History: Not recorded (New land, fallow) sown?

Variety: Not recorded.

Basal: MoO_3 2 oz/ac, urea 50 lb/ac, super 180 lb/ac.

Results: Effects of combinations of copper and zinc

Zinc Oxide lb/ac	Bu/ac Bluestone lb/ac				
	0	2½	5	7½	10
0	13.3	15.6	17.8	18.0	18.2
¾	-	11.3	14.6	16.3	16.5
1½	-	-	12.7	13.4	14.1
3	-	-	-	-	14.1

Trial was heavily grazed by kangaroos up to earing. The worst damaged end was cut back one chain. However the possibility of selective grazing of treatments cannot be discarded and the results should be viewed with some doubt. As they stand the results show zinc oxide depressed yields at all levels of bluestone. Without zinc oxide, bluestone 5 lb/ac gave near maximum yields. With zinc oxide ¾ lb/ac, bluestone 7½ lb/ac appeared superior to 5 lb/ac. With zinc oxide 1½ lb/ac, bluestone 10 lb/ac may have been better than 7½ lb/ac. This type of response pattern occurs infrequently but is nevertheless cause for some concern, particularly as there is no means of identifying the predisposing conditions.

3. 69LG9/2247EX - W. Dykes, Sth Newdegate.

Soil Type: Yellow brown earthy sand over gravel in soil association Ms 8.
Original Vegetation: Not recorded.
History: Not recorded (New land, fallow) sown 16/5/69.
Variety: Not recorded.
Basal: MoO₃ 2 oz/ac, Urea 54 lb/ac, super 200 lb/ac.
Results: Effects of combinations of copper and zinc.

Zinc Oxide lb/ac	Bu/ac Bluestone lb/ac				
	0	2½	5	7½	10
0	16.2	15.8	16.8	16.7	15.9
¾	-	16.8	17.4	17.4	16.7
1½	-	-	17.2	17.7	17.3
3	-	-	-	-	16.8

Effects on grain yield of copper and zinc application are barely detectable. When viewed at the flowering stage it appeared that there would be some response to copper to low rates.

4. 69N 3/2247EX - Research Station, Newdegate.

Soil Type: Yellow brown earthy sand with gravel at 6 inches in soil association Ms 8.
Original Vegetation: Scattered mallee, low acrub.
History: Chained, burnt, ploughed & rotraked summer 1969. Sown 17/6/69.
Variety: Gamenya.
Basal: Super 200 lb/ac, MoO₃ 2 oz/ac, Urea 46 lb/ac.
Results: Effects of combinations of copper and zinc.

Zinc Oxide lb/ac	Bu/ac Bluestone lb/ac				
	0	2½	5	7½	10
0	13.8	15.6	16.3	16.6	14.6
¾	-	17.2	16.6	17.7	17.7
1½	-	15.3	17.7	16.3	16.1
3	-	-	16.1	-	16.3
LSD Treats P = 0.05		1.9			
Zinc Means in 4 x 3 facto rial - P = 0.05		1.0			

Copper and zinc increased yields. Cu 2½ appeared inferior to Cu 5 which was equal to Cu 7½ but the differences were not statistically significant.

Zn ¾ was better than Zn nil. The best "lowest rate" combination was Cu 2½ Zn ¾ with some suggestion that Cu 5 Zn ¾ may have been better.

It is interesting that the Cu 5 Zn 3 treatment was not markedly inferior to the Cu 10 Zn 3 as might have been suggested from 66N14 in which Cu 10 appears to have been better than Cu 5 both with 2 lb/ac zinc oxide.

5. 69LG8/2247EX - D. McDonald, Newdegate.

Soil Type: Brown loamy sand with coarse angular gravel in soil association Ms 8.

Original Vegetation: Mallee, tussock.

History: 1st Crop on newly cleared land in 1968. Supposed to have had 1 bag/ac Cu 5 Zn 1½ Mo but the symptoms of copper deficiency appeared in the crop & headlands. Sown 21/5/69

Variety: Falcon.

Basal: Super 190 lb/ac, Urea 54 lb/ac, MoO₃ 2 oz/ac.

Results: Effects of combinations of copper and zinc.

Zinc Oxide lb/ac	Bu/ac Bluestone lb/ac				
	0	2½	5	7½	10
0	6.6	6.7	6.7	6.2	6.4
¾		7.1	6.5	6.9	7.0
1½			6.4	5.9	6.7
3					6.8

Yields were low. No signs of copper deficiency or treatment differences were observed. Differences were not statistically significant nor does there appear to be any consistent trend.

These results fail to confirm the copper deficiency suspected in the preceding crop.

6. 69LG5/2247EX - C. Mansfield, Nth Lake Magenta.

Soil Type: Pallarup (= Circle Valley) sand with clay at 4 to 6" in soil association S1 30.

Original Vegetation: Mallee.

History: Not recorded (New land). Sown 14/5/69.

Variety: Not recorded.

Basal: Urea 50 lb/ac, P & S = 180 lb/ac super, MoO₃ 2 oz/ac.

Results: Effects of combinations of copper and zinc.

Zinc Oxide lb/ac	Bu/ac Bluestone lb/ac					Mean	40
	0	2½	5	7½			
0	15.1	14.8	15.3	15.1	15.08	15.0	
¾	15.3	15.2	15.0	15.5	15.25		
1½	15.7	15.6	15.7	15.9	15.73		
3	15.7	15.7	16.2	15.9	15.88		
Mean	15.45	15.33	15.55	15.60			
12	15.9					16.0	

Plain super (nil Mo) = 15.8 Super 240 Mo Cu 5 Zn ¾ = 17.7
Aerophos + gypsum = 13.9

There appeared to be a consistent increase due to zinc application up to $1\frac{1}{2}$ lb/ac zinc oxide. Bluestone had no effect on grain yields. Aerophos + gypsum yielded almost 2 bu/ac less than plain super. Super 240 yielded over $2\frac{1}{2}$ bu/ac more than the corresponding super 180 treatment.

When observed September 22nd patches in the aerophos + gypsum treatment were showing severe zinc deficiency symptoms and there was a maturity response to $\frac{3}{4}$ to $1\frac{1}{2}$ lb/ac zinc oxide. Bluestone 40 lb/ac had retarded growth and delayed maturity. The effect on maturity was partially reversed by zinc oxide 12 lb/ac.

7. 69LG6/2247EX - C. Mansfield

This trial was done to measure any differential effects of a limited range of trace element-super mixtures on wheat grown on three depth phases in a twenty chain transect on Pallarup sand.

Soil: Pallarup (= Circle Valley) sand with clay at 6 to 7 24". In soil association S1 30.

Other details as for 69LG5

Fertilizer Mixture	Bu/ac			
	Soil 1	Soil 2	Soil 3	Mean
2. Aerophos + gypsum = Super 180 lb/ac	11.5	17.9	12.7	14.0
1. Super 180 lb/ac	13.5	18.2	15.0	15.6
7. " + MoO ₃ 2 oz + Zn Oxide $\frac{3}{4}$ lb/ac	12.7	18.1	15.8	15.5
8. " + " + " $1\frac{1}{2}$ "	13.0	18.3	16.7	16.0
6. " + " + Bluestone $2\frac{1}{2}$ "	15.5	19.0	15.1	16.5
5. " + " + " 5 "	15.9	20.0	16.1	17.3
4. " + " + " $2\frac{1}{2}$ "				
3. " + " + Zn Oxide $\frac{3}{4}$ lb/ac	15.8	19.2	16.0	17.0
" + " + Bluestone 5 lb/ac				
" + " + Zn Oxide $\frac{3}{4}$ lb/ac	16.8	20.3	16.9	18.0
Soils Means	14.3	18.9	15.5	
LSDs P = 0.05	Between Treats = 2.37			
	" Soils = 0.84			
	" mixtures =			1.37

Soil 1 : Clay occurred deeper than 24"

Soil 2 : " " at 16 to 24"

Soil 3 : " " at 6 to 18"

Because the fertilizer mixtures tested do not form a continuous related series with regard to composition and in the absence of some important combinations (e.g. Super Mo; Super Mo Cu with Zn $1\frac{1}{2}$) conclusions as to which component the fertilizer treatment differences were due are partly speculative. However the trial shows clear differences between some treatments and between the different depth phases of the soil.

For soils 2 & 3 (clay shallower than 24") the only differences with significance at 5% are the low yielding aerophos + gypsum treatments in each case. For Soil 2 only, the copper containing mixtures appeared to give higher yields than did mixtures having no copper.

On soil 1 the superiority of the copper containing mixtures was even more clear than on soil 2.

Thus it appeared that there was a definite benefit from copper particularly as the depth to clay increased.

Generally there appeared to be only a small if any benefit from adding zinc to ordinary super although the aerophos + gypsum treatments contained patches of plants showing zinc deficiency symptoms. Perhaps zinc added to super was slightly beneficial on soil 3.

Cu 5 appeared better overall than corresponding Cu $2\frac{1}{2}$ treatments but the differences were not statistically significant.

Super Mo Cu 5 Zn $\frac{3}{4}$ gave highest yields in the trial but two other mixtures, Super Mo Cu $2\frac{1}{2}$ Zn $\frac{3}{4}$ & Super Mo Cu 5 were not statistically worse than the best. It is probable that Mo had no

effect but treatments which would allow the determination of the Mo effect were omitted.

In this case the intermediate soil depth phase gave the highest yields. The deepest soil gave lowest yields when no copper was used but with the addition of copper the deepest and the shallowest soils yielded similarly.

As an exploratory trial this one was rather interesting but not definitive. Clear benefits to copper had not previously been demonstrated on the Pallarup-Circle Valley fasc of soil series. The transect being 20 chains long is more representative of the paddock than the usual 5 chain long trial and the results give some indication of within paddock variation with regard to level of yields and nutritional deficiency.

2. Rates and Sources of Zinc on Wheat:

1. 69ES1/2247EX - R. Fletcher, Salmon Gums East.

Soil Type: Doust sand (2' sand over domed clay) in soil association Ya 29.

Original Vegetation: Scattered mallee titree banksia.

History: Burnt & ploughed 1968, rootraked & ploughed back March-April 1969. Sown 13/5/69.

Variety: Gamanya.

Basal: Urea 50 lb/ac, P & S equivalent to super 180 lb/ac.

Results: 1. Effects of rates and sources of zinc with or without the addition of copper (all with super 180 lb/ac).

Zinc lb/ac	Form	Bluestone lb/ac		
		0	2½	7½
0	-	17.0		
1.13	Oxide	16.4	17.9	
	Sulphate	16.3	16.0	
2.26	Oxide	16.0		
	Sulphate	16.8		
25.13	Oxide	8.7		10.1
	Sulphate	10.9		11.4

At the low rates zinc had no effect on yields. At the high rate zinc depressed yields with the oxide slightly more harmful than the sulphate. Copper had no marked effect on yields but appeared to slightly alleviate the harmful effects of the high zinc rate.

2. Effects of 400 p.p.m. Zn in plain super.

Treatment	Yield bu/ac
Aerophos + gypsum	15.9
Super	17.0

Aerophos + gypsum plots appeared slightly zinc deficient during the growing season but the difference in grain yield was too small to be statistically significant.

3. Effect of additional gypsum

Treatment	Yield bu/ac
Super	17.0
Super + gypsum 74 lb/ac	19.9

Gypsum 74 lb/ac added to super 180 lb/ac resulted in an obvious improvement in growth and colour of the wheat crop during growth which is reflected in the 3 bushels/acre difference in yield. The reasons for this are not clear. The fertilizer is being analysed to check that its composition was true to description.

This extra gypsum treatment was included in the trial merely for comparison with the high zinc sulphate treatment in case any response to zinc sulphate was due solely to its sulphur content. The unexpected response to gypsum is remarkable and deserves further investigation.

3. Zinc Spray treatments on Wheat.

1. 69ES2/2247EX - R. Fletcher, Salmon Gums East.

Soil Type: Doust sand (3' sand over domed clay) in soil association Ya 29.

Vegetation & History as for 69ES1.

Variety: Gamenya, sown 9/5/69.

Basal: Aerophos & gypsum to give P & S equal to 120 lb/ac super (this quantity is below that which gives maximum growth on this soil but was applied as a result of experimental difficulties).
Urea 50 lb/ac.

Results:

Concentration per cent	Volume gal/ac	Zinc sulphate Time applied after seeding		Zinc Rayplex Time applied after seeding		Means
		1 month	2 months	1 month	2 months	
0.75	11	7.2	8.0	7.9	7.4	7.7
1.5	11	8.2	7.7	7.7	8.0	7.9
1.5	5.5	7.7	8.0	8.0	8.4	8.0
Means, Sources, Times		7.7	7.9	7.9	8.0	
Means, Sources		7.8		8.0		
Nil zinc		6.8				

Zinc deficiency symptoms were observed on the nil zinc plots and the 1 bu/ac difference between the nil treatment and the rest would possibly be statistically significant. However no other differences would be.

Of interest was the absence of any sign of plant damage with any treatment.

4. Effects of Molybdenum on Wheat Yield.

A limited number of nil molybdenum treatments were included in the copper, zinc rate trials in the Lake Grace district to obtain additional data.

Experiment	Blue- stone lb/ac	Zinc Oxide lb/ac	Response to 2 oz/ac Mo O ₃	Is Molybdenum recommended for crops or clovers on this soil type?
69LG4	0	0	-0.9	Yes
	2½	¾	-0.5	
	5	1½	2.7	
	Mean		0.4	
69LG7	5	¾	0.8	Yes
69LG9	5	¾	-0.6	Yes
69N 3	2½	¾	0.0	Yes
	5	1½	0.6	
	Mean		0.3	
	69LG8	5	¾	
69LG5	0	0	-0.7	No
	2½	¾	0.6	
	5	1½	-0.4	
	Mean		-0.2	

No marked responses to molybdenum occurred in these trials.

5. Copper residual for Crop and Animal Production.

66N14/2086 - Newdegate Research Station.

Block 3 was cropped to wheat with the scheduled initial copper applications. Copper deficiency on the nil plots did not appear to be as severe during the vegetative phase as in 1968 but grain yield on the nil copper plots was less than half of that obtained from any plot which had copper.

First year crop results for Blocks 1, 2 & 3 expressed as a percentage of the best plot each year are summarized in the table.

Table showing the relative grain yields according to treatment for the 1st wheat crop of Blocks 1, 2 & 3 of 66N14 (highest yielding plot = 100 each year).

(Basal: super 180 lb/ac, Zinc oxide 2 lb/ac, Urea 40 lb/ac MoO₃ 2 oz/ac).

Treatment	Block 1(67)	Block 2(68)	Block 3(69)	Mean
1. Nil	35.1	0.8	34.3	23.4
2. Bluestone 2½ lb/ac	90.1	33.3	88.7	70.7
3. 5 "	73.9	41.7	82.1	65.9
4. 7½ "	77.5	83.3	78.6	79.8
5. 10 "	100.0	93.3	99.3	97.5
6. 10 "	73.9	100.0	100.0	91.3

At this site with 2 lb/ac zinc oxide there has been an apparent response to the highest rate of bluestone used.

Block 2 was sown to Geraldton sub clover and fenced. White and black sheep were put into Block 1. The drought resulted in very poor pasture growth which prevented the plots from carrying sheep continuously as planned.

Sub clover seed set on block 1 appeared maximal with 2½ lb/ac bluestone (lowest applied rate) in both 1968 and 1969.

The nil plot was relatively worse in 1969 than in 1968.

8.

On Block 2 seed set was not limited by copper supply on the nil plot in 1969. Due to the drought, seed set on block 2 was poor at about 40 lb/ac seed.

Eighty black ewes have been mated to produce the weaner lambs required for the trial. This number is about twenty fewer than that required to allow a safety margin.

Blocks 1 & 2 will be stocked as soon as there is enough feed to carry the sheep. Block 3 still remains to be fenced and it is to be hoped that Research Station staff will be able to complete this in time for stocking in late July.

6. Copper, zinc and molybdenum on pasture legumes sown after a crop to which trace elements were applied.

Additional data were obtained in 1969. This, together with previously collected data will be evaluated when the series is completed.

27.4.70.
JWG:EH.