Zinc nutrition trials

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SUMMARY

In previous years, trials and demonstrations have highlighted zinc deficiencies in both cereals and pulses, which could provide farmers substantial profits over the cost of zinc. Six trial sites were chosen, all with adequate zinc histories, to demonstrate advantages of supplying extra zinc to wheat crops. As there were no significant yield responses to the various applications of zinc, it was concluded if adequate zinc enriched granular fertiliser had been regularly applied in previous years there was no benefit from the application of additional zinc.

Most of the Mallee soils are highly responsive to zinc fertiliser as they are alkaline, low in organic matter and have free limestone present. Farmers are applying higher levels of phosphorous and nitrogen when growing crops such as canola or when aiming to increase cereal yields. To maintain proper nutrient balance zinc fertiliser use may also need to be increased. The general recommendation is to apply 2-3kg of zinc/ha with granular fertilisers over a 3-4 year period.

Trials have consistently shown that application of granular fertiliser zinc to the soil at rates of about 2.5kgZn/ha will eliminate any deficiencies. Demonstrations with foliar zinc, seed dressings and spraying zinc on the soil in recent years have achieved substantial yield increases.

METHOD

Wheat was sown at each site with seven methods of applying zinc fertiliser. Granular fertiliser MM1, soil application prior to sowing, seed dressing, foliar spray and zinc coated urea fertilisers were used as zinc sources. MAP was used as a control treatment. Trials were sown at sites with zinc histories typical of the district. (Table 4.16). All sites had had zinc applied previously and none could be classified as zinc deficient. The treatments were replicated three times in a randomised complete block design. Grain yield and protein content was measured.

Table 4.16 Fertiliser history and total zinc applied in last five years at all sites

Year	Birchip	Charlton	Sea Lake	Kaniva	Werrimull	Rupanyup
1994	35 GLSZn	35 GLSZn	-			60 GLSZn
1995	75 DAP	75 DAP	64 DAP			80 GLSZn
1996		-	75 GLSZn	150 32:10 1% Zn	65MM1	80 DAP
1997	80 GLSZn	80 GLSZn	DAP	100 32:10 1% Zn	65 MM1	100 GLSZn
1998	-	-	100 SSP	110 GLS	65 MM1	100 DAP
Total Zn	**2.4kg**	**2.4kg**	**1.5kg**	**2.5kg**	**3.9kg**	**4.8kg**

Table 4.17 Products used

Product	Description	Rate	Zinc (kg/ha)
MAP	10-22-0-1	93kg/ha	
Zinc Sulphate Heptahydrate ($ZnSO_4$) (soil)			1kg/ha
Zinc Oxide (seed treatment)		4L/t	0.19kg/ha
Zincsol (foliar at tillering)		2L/ha	0.34kg/ha
MM1	8-19-0-3 2%Zn	106kg/ha	2.1kg/ha
MM1*	8-19-0-3 2%Zn	77kg/ha	1.49kg/ha

Zincaline Zn 4%	9-20-0-2 4%Zn	100kg/ha	4kg/ha
Zincaline Zn 4%*	9-20-0-2 4%Zn	70kg/ha	2.7kg/ha
Zinc coated urea 4.5%	46-0-0-0 4.5% Zn	105kg/ha	4.5kg/ha

*lower rate at Werrimull and Sea Lake only

RESULTS

Birchip - Limited significant differences with no clear response to zinc.

Charlton -some significant difference between treatments but there was no clear response to the rate or form of zinc applied. Highest yield and profit produced by MM1 with urea (Table 4.18).

Kaniva -no significant different response to the rate or form of zinc applied. Major response in yield at this site was in relation to the application of nitrogen. MAP with zinc coated urea had the highest profit. The trial site was substantially damaged by a hailstorm in late spring.

Rupanyup -some significant difference in crop yields (Table 4.18). MAP with soil and seed applied and Zincaline yielded significantly better than MM1 with soil and seed coating. However the above treatments were not significantly better than the control treatment. All other treatments showed no response to the various methods of applying zinc.

Table 4.18 Wheat **y**ields at Birchip, Charlton, Kaniva and Rupanyup

No	**Treatment**	**Yield (t/ha)**			
		Birchip	**Charlton**	**Kaniva**	**Rupanyup**
1	MAP at 20P[1]	3.02	3.42	2.22	2.97
2	MAP at 20P + soil $ZnSO_4$[1]	2.95	3.40	2.29	3.02
3	MAP at 20P + Zn seed coating[1]	2.96	3.81	2.39	2.97
4	MAP at 20P + Zincsol [1]	2.60	3.82	2.46	2.92
5	MAP at 20P + soil $ZnSo_4$ + Zn seed coating[1]	2.72	3.08	2.01	3.07
6	MAP at 20P + Zn seed coating, Zincsol[1]	2.53	3.67	2.38	2.94
7	MAP at 20P + $ZnSO_4$, Zn seed coating, Zincsol[1]	2.46	3.53	2.00	3.01
8	MM1 at 20P[1]	2.98	4.13	2.55	2.98
9	MM1 at 20P + soil $ZnSO_4$[1]	2.81	3.38	2.22	2.88
10	MM1 at 20P + Zn seed coating[1]	2.73	3.38	2.07	2.98
11	MM1 at 20P + Zincsol[1]	2.87	3.53	2.51	3.19
12	MM1 at 20P + soil $ZnSO_4$ + Zn seed coating[1]	2.81	3.31	2.28	2.72
13	MM1 at 20P + Zn seed coating + Zincsol[1]	2.61	3.48	2.38	2.82
14	MM1 at 20P + $ZnSO_4$ + Zn seed coating + Zincsol[1]	2.62	3.24	2.38	2.88
15	Zincaline 9-20-0-2 Zn4%[1]	2.96	3.31	2.28	3.06
16	MAP at 20P + Zn coated (4.5%) urea 46N	3.05	3.52	2.51	2.95
17	MAP at 20P (no urea)			2.22	
	Coefficient Variance	**11.5**	**11.3**	**15.6**	**8.7**
	LSD(p=0.05)	**0.391**	**0.628**	**0.46**	**0.285**

[1] **plus urea at 46N**

Werrimull (Table 4.19) There were limited significant yield responses from the various applications and combinations of applications of zinc fertiliser and various rates of zinc and nitrogen fertiliser.

Treatment 14, where all zinc fertilisers were used in combination with MM1 yielded significantly better than MM1 alone (No. 1), MAP with soil treatment (No. 2) and MAP with

seed coating and foliar spray (No. 6). It is difficult to draw conclusion as to the most responsive zinc treatment.

Treatments 14 and 15 applied the highest rate of zinc fertiliser (3.37kg/ha and 2.80kg/ha respectively). These three treatments were the highest yielding and the most profitable. The yield responses to high zinc applications agree with other trials and demonstrations carried out in Victoria and South Australia.

Sea Lake No treatment yielded significantly different in response to rate of zinc or form of zinc applied (Table 4.19).

Table 4.19 Wheat yields at Werrimull and Sea Lake

No	Treatment	Yield (t/ha)	
		Werrimull	Sea Lake
1	MM1 at 10P	1.61	2.87
2	MAP at 14P + ZnSO4	1.60	2.99
3	MAP at 14P + Zn seed coating	1.82	2.86
4	MAP at 14P + Zincsol	1.84	3.24
5	MAP at 14P + ZnSO4 + Zn seed coating	1.78	3.11
6	MAP at 14P + Zn seed coating + Zincsol	1.60	2.97
7	MAP at 14P + ZnSO4 + Zn seed coating + Zincsol	1.73	3.27
8	MM1 at 14P	1.80	2.94
9	MM1 at 14P + ZnSO4	1.67	3.36
10	MM1 at 14P + Zn seed coating	1.72	3.07
11	MM1 at 14P + Zincsol	1.74	3.23
12	MM1 at 14P + ZnSO4 + Zn seed coating	1.93	3.17
13	MM1 at 14P + Zn seed coating + Zincsol	1.82	2.80
14	MM1 at 14P + ZnSO4 + Zn seed coating + Zincsol	2.06	3.19
15	Zincaline 9-20-0-2 at 14P	1.95	2.72
16	DAP at 14P	1.89	2.94
17	MAP at 14P	1.73	3.13
18	MM1 at 18P	2.00	3.03
	Coefficient Variance	**15.0**	**10.5**
	LSD (P = 0.05)	**0.406**	**0.485**

INTERPRETATION

Each trial site, except Sea Lake, had adequate zinc fertiliser applied previously to meet the accepted levels of 2-3 kg/ha every 3-4 years. Sea Lake received 1.5kg in 1996 (Table 4.16). It can be assumed that no sites were zinc deficient and the additional zinc applied was of no benefit.

Zinc Sulphate Heptahydrate applied to the soil must be thoroughly incorporated by tillage to ensure it is available to the crop. In these trials, and possibly in many commercial crops, soil applied zinc was not in the root zone and therefore of no benefit.

Seed dressings are often effective in correcting nutrient deficiencies but consideration should be given to the economics of these products. They are not a long-term solution when used in isolation. They are more effective when used in conjunction with a granular fertiliser.

Foliar applied zincsol is also effective in correcting zinc deficiency. Though not a long-term solution, it is an effective solution to deficiencies detected during the growing season.

Granular fertilisers are the most effective method of maintaining available zinc levels in the soil. The regular use of these products should preclude the use of other application methods.

COMMERCIAL PRACTICE

If zinc is applied regularly as a granular fertiliser, as Grain Legume Super Zinc, Mallee Mix or Technitrace, in the cropping rotation then the additional application of soil applied, seed applied and foliar applied treatments may not be necessary and unwarranted.
Grain growers should have an understanding of each paddock's fertility, soil pH and free limestone level and how these factors influence the availability of zinc.

Records should be maintained for zinc application and nutrient audits completed. The recommended levels of 2-3 kg/ha of zinc every 3-4 years should be targeted. If any paddocks do not meet these levels, the application of a granular fertiliser should be considered first, followed up with foliar tissue tests during the growing season. A foliar tissue test is an accurate and timely method of determining if a foliar application of zinc is needed.
If zinc has never been applied and zinc deficient crops have resulted, then a combination of applications may be necessary. The application of granular fertiliser initially will not necessarily spread zinc throughout the soil, therefore seed treatments and foliar applications could all be beneficial in this situation.

Finally, though the effect of sulphonylurea herbicides was not considered in these trials, consideration should be given to their use. Sulphonylurea herbicides may induce zinc deficiencies in some crops in some years by damaging the crop root system and impairing its ability to access zinc. If this occurs or is suspected, tissue testing can be used to confirm the problem and foliar applications of zinc may be required.

Ref: Grains Industry ADVICE "Combating trace element deficiencies with seed dressings"