1973

Mineral nutrition of Unicrop lupins

J. W. Gartrell

J. W. GARTRELL

Mineral Nutrition of Unicrop Lupins

1. 73M035/3074EX. Williams Bros. Lancelin.

Soil Type: Yellow sand known to be extremely difficient in Cu and Zn for cereals.

Original Vegetation: Banksia, Xmas tree, blackboy, scrub.

History: Rolled, burnt and fallowed February - March 1973.
Cultivated by scarifier just before seeding.
Note: No previous trace elements.
Trial planted May 17 and 18 1973.

Variety: Uniharvest at 66 kg/ha (about 25% of this was split seed).

Basal: 200 kg/ha super drilled with seed + 200 kg/ha Topdressed June 5, 1973.
Seed was not inoculated. Fertilisers were all drilled together at seeding.

Treatment 13 arose through error when hoses were inadvertently left out of boots. Emus ate a high proportion of primary spikes.

Treatments: 13 Reps: 4 Plot size 2.1 m x 95 m Randomised Blocks.

Treatments: (Rates in kg/ha)

1. "All" = Basal + KCl 100, $MnSO_4$ 14, Borax 2, $CuSO_4$ 5.5, ZnO 1.65, MoOx 0.014, $CoSO_4$ 0.042.
2. " - K" = Treatment 1 less KCl
3. " - Mn" = Treatment 1 less Mn SO_4
4. " - B" = Treatment 1 less Borax
5. " - Cu" = Treatment 1 less Cu SO_4
6. " - Zn" = Treatment 1 less Zn 0
7. " - Mo" = Treatment 1 less Mo Ox
8. " - Co" = Treatment 1 less Co SO_4
9. Basal only
10. "CuZnMo" = Cu SO_4 5.5, Zn 0 1.65, Mo Ox 0.014
11. "CuZnMoMn" = Cu SO_4 5.5, Zn 0 1.65, Mo Ox 0.014 + Mn SO_4 14
12. "CuZnMoB" = Cu SO_4 5.5, Zn 0 1.65, Mo Ox 0.014 + Borax 2
13. "Tubes Out" = Treatment 11 with tubes out.

Observations 31.7.1973: 73M035 - Lancelin

Plots were rated for growth and colour by J.W. Gartrell.
Rated 1 - 5 (1 worst, 5 best)

Approximate points in rating range:

1. Plants yellow, nodulation retarded. Height 10 - 16 cm
3. Most plants green 15 - 20 cm tall with a scattering of yellow plants 10 - 16 cm tall the yellow plants being slow to nodulate.
5. Most plants dark green 15 - 20 cm tall, well nodulated.

TABLE 1

Treatments	I	II	III	IV	TOTAL	MEAN
1. K Mn B Cu Zn Mo Co	3	5	5	5	18	4.50
2. - K	4	5	5	4	18	4.50
3. - Mn	3	4	3	3	13	3.25
4. - B	4	5	5	5	19	4.75
5. - Cu	5	5	5	4	19	4.75
6. - Zn	3	4	4	4	15	3.75
7. - Mo	4	5	5	4	18	4.50
8. - Co	3	2	3	2	10	2.50
9. Super only	1	1	2	2	6	1.50
10. Cu Zn Mo	1	1	1	2	5	1.25
11. Cu Zn Mo Mn	3	3	3	3	12	3.00
12. Cu Zn Mo B	2	1	2	2	7	1.75
13. Tr 11 with tubes out	1	1	1	1	4	1.00
	37	42	44	41	164	3.15

1. Split up to show Co effect.

All - Co	2.50
All	4.50

2. Split up to show Mn effect.

	Cu Zn Mo	All	Mean
Mn nil	1.25	3.25	2.25
Mn 14	3.00	4.50	3.75
Mean	2.13	3.88	

Most of the difference between Cu Zn Mo and All is ascribable to the Co in the All treatment.

3. Split up to show Zn effect.

All - Zn	3.75
Zn	4.50

Remarks

1. Clear benefit from Co (Mn was present).
2. Clear benefit from Mn (treatments were such that it was shown to happen in both the presence and absence of Co).
3. Smaller benefit from Zn (Co and Mn present).
4. At the time the Co effect appeared slightly larger than the Mn.

The degree to which these effects were due to the facilitation of nodulation (and N fixation) as opposed to direct effects in the plant itself is not distinguishable on the information obtained.

Vegetative Yield 28.9.1973: 73M035 - Lancelin

(8 quadrats ea 4 rows x 24" per plot)

TABLE 2

Treatment	D.M. kg/ha
1. All	2010
2. - K	2092
3. - Mn	1547
4. - B	1976
5. - Cu	1570
6. - Zn	1625
7. - Mo	2648
8. - Co	1985
9. Basal	1052
10. Cu Zn Mo	1054
11. Cu Zn Mo Mn	1440
12. Cu Zn Mo B	1098
13. Treatment 11 with tubes out	1322

Caution: The variability was large and the significance of any differences must be in doubt. The apparent responses to Mn and Zn are consistent with earlier observations and those concomitant with the sampling. However, this data fails to show the earlier clearly observable benefits of Co and further there appears to have been a large effect of Cu which was never observed. In addition, treatment 13 always appeared to be markedly inferior to treatment 11.

Grain Yields: 73M035 - Lancelin

(Area harvested = 1.82 x 80 m per plot)

TABLE 3

Treatment	Grain kg/ha
1. All	673
2. - K	841
3. - Mn	195
4. - B	794
5. - Cu	545
6. - Zn	505
7. - Mo	720
8. - Co	424
9. Basal	141
10. Cu Zn Mo	121
11. Cu Zn Mo Mn	767
12. Cu Zn Mo B	215
13. Treatment 11 tubes out	161

1. Split up to show Mn effect.

	Cu Zn Mo	All	Mean
Mn nil	121	195	158
Mn 14	767	673	720
Mean	444	434	

2. Co effect

All - Co	424 kg/ha
All	673

3. Zn effect

All - Zn	505 kg/ha
All	673

4. Cu effect

All - Cu	545 kg/ha
All	673

5. K effect

All - K	841 kg/ha
All	673

Remarks

1. Mn increased yields by a factor of 4.6 on average and perhaps more where K, B and Co were not applied.
2. Co, Zn and Cu appeared to increase yields by 60 to 20%.
3. K appeared to reduce yield by 25%. Statistical analyses are yet to tell us the chances of these differences not being real.

Degree of seed damage: 73M035 - Lancelin

(From examination of the seed from 50 pods from (a) primary and (b) lateral inflorescences from each plot).

Seed was classified according to the 5 categories:

N = Normal sized healthy seed.

I = Brown or "china white" necrotic tissue on edge of testa. Seed normal size.

S = Seed normal size but testa split.

E = Seed shrivelled with cotyledons partly extruded.

A = Small seed.

TABLE 4

Treatments		% of seeds in each category				
		N	I	S	E	A
1. All	Primaries	89	0	6	1	8
	Laterals	53	4	28	12	4
3. - Mn	Primaries	19	22	27	26	6
	Laterals	8	15	6	67	5
10. Cu Zn Mo	Primaries	7	23	21	44	5
	Laterals	11	10	14	58	8
11. Cu Zn Mo Mn	Primaries	68	1	25	1	5
	Laterals	40	6	32	15	8
5. - Cu	Primaries	84	3	7	1	5
	Laterals	57	9	12	16	7
6. - Zn	Primaries	87	0	3	0	10
	Laterals	66	3	14	4	13
8. - Co	Primaries	81	3	8	1	7
	Laterals	51	10	20	14	5
Mean	Primaries	62	7	14	11	7
	Laterals	41	8	18	27	7

Categories I, S and E represent an increasing degree of severity of the split seed syndrome. The proportion of small seed (category A) does not vary with treatments which affect the incidence of split seed. However, the zinc deficient treatment 6 appeared to have a higher incidence of small seed.

It is easier to discern the effects of treatments on split seededness by confining attention to either categories E or N. Category E is probably the most important in economic terms as seed in the other categories is full size and yield and quality as stock feed are little affected by the occurrence of categories I and S.

1. Split up to show Mn effect on % split and shrivelled seed (category E)

	PRIMARIES			LATERALS		
	Cu Zn Mo	All	Mean	Cu Zn Mo	All	Mean
Mn nil	44	26	35	58	67	63
Mn 14	1	1	1	15	12	14

2. Split up to show Zn effect on % split and shrivelled seed (category E)

	Primaries	Laterals	Mean
All - Zn	0	4	2
All	1	12	7

Observation: Inspection on October 2, 1973 showed that all treatments that had Mn matured normally whereas the nil Mn treatments all showed marked regreening. Mn had reduced split seed.

Remarks:

1. Manganese virtually eliminated the shrivelled split seed from the primary inflorescence and reduced it from 63 to 14% in the laterals.

2. None of the other elements which gave increased grain yields reduced the degree of split seed.

3. Zinc deficiency or at least the absence of applied Zn 0 gave a noticeably lower level of split seededness particularly in the laterals. It may be that either (a) Zn was the only other element apart from Mn to increase vegetative growth and that this increased growth diluted the Mn down to a more severely deficient level (see notes on vegetative samples Table 2). Or, (b) Zn antagonised Mn uptake in the root zone. It is unlikely that any antagonism occurred inside the plant.

Summary of the Results from 73M035 - Lancelin

1. Manganese: (a) Early growth to mid August: Without Mn, the plants appeared to be slow to nodulate and nitrogen deficient.

(b) Spring to maturity: Without Mn, plants did not grow as vigorously as where Mn fertiliser had been applied. Nil Mn plants continued to be slightly chlorotic.

In late September most of the Mn treated plants began to mature normally while untreated plants showed the typical prolonged vegetative growth stage associated with split seed. Seed splitting commenced in this period. Mn application virtually eliminated shrivelled split seed from the primary inflorencence and cut it from 63 to 14% on the laterals. Mn application increased harvested grain yield 4.6 times from 158 to 720 kg/ha. Mn deficiency has occurred in yellow flowered sweet lupins grown on this soil type but split seed had not been noticed in these cases. Mn deficiency of cereals had not been recognised on this soil type.

2. Copper: No effects of copper treatment were apparent during the vegetative phase. Copper application increased grain yield from 545 to 673 kg/ha Wheat grown on this soil type in the absence of any previous or current Cu application is invariably wiped out by copper deficiency which confirms previous evidence that Uniharvest lupins are less susceptible to copper deficiency than wheat. Copper did not affect the incidence of split seed.

3. Zinc: Zinc application increased the vegetative growth of lupins. The nil zinc plants were a normal green colour but the dried out mature plants were darker than Zn treated plants. Zn increased grain yield from 505 to 673 kg/ha. Zn had no effect on the incidence of split seed but 12% small seed occurred on the laterals of nil Zn plants compared with 4% on Zn treated plants. This soil type is quite Zn deficient

for oats, wheat and clovers, but like copper, one application is effective indefinitely.

4. Cobalt: Cobalt increased vegetative yield and in the early stages its effects appeared very similar to Mn in that nodulation appeared to be retarded in the absence of Co. As the season progressed the chlorosis associated with the nil Co treatment appeared to diminish although plant growth continued to be inferior to that where Co had been applied. Co increased grain yield from 424 to 673 kg/ha. Co had no effect on split seed. Cobalt effects on sweet lupins need further investigation.