Boron - should we be worried about it

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KEY MESSAGE

Soil B levels are marginal in sandy, acid soils in West Australia, especially those developed on sandstones of the Dandaragan plateau.

In pots, B deficiency decreased seed yield of canola and lupin in sandy acid soils from the west Moora-Dandaragan area.

Low B levels in seeds of lupin and canola harvested from low B soils decreased seed viability and vigour.

Foliar B increased canola seed yields in simple on-farm trials in 1998 in the Great Southern Region, but in 14 field trials carried out in 2000 and 2001, no positive responses to soil or foliar B application were found.

No general recommendations for B fertiliser application seem warranted at this stage but soil and plant analysis should guide its use on a case-by-case basis for the time being.

Care needs to be taken not to overuse B as toxicity was induced in lupin and canola on sandy soils on the Yuna sandplains with only 5-10 kg borax/ha

AIMS

- Determine the spatial distribution of B deficiency in canola and lupin; these crops are more sensitive to B deficiency than cereals.
- Investigate the role of B in soil and plants for grain yield of canola and lupin; and
- Develop management options for B to take account of soil properties and crop requirements.

METHODS

Young leaves of canola and lupin crops and soil (0-10;10-30 cm) were sampled for B analysis at over 150 sites in the wheatbelt, predominantly on sandy soils in 1998. Surface horizons of 73 Reference Soils of SW Australia were analysed for hot $CaCl_2$ extractable B, and these values were correlated with soil properties (pH, clay, sand) reported by McArthur (1991). From the above Reference Soils, 14 (including sub-soils of 4 soils) were selected for a pot experiment with canola and lupins (8 soils only) as test crops. Plants were grown in pots with and without added B, and harvested at maturity for seed yield. On farm trials were carried out in 1998 using foliar B applications. In 2000 and 2001 cropping seasons, 14 field trials tested soil and foliar B fertiliser applications.

RESULTS

Levels of B in young leaves of canola and lupin crops in 1998 and in soil samples suggested that 10-20% of sites were potentially B deficient. Although predominantly sandy soils were selected, these sites were widely distributed throughout the wheatbelt.

In Reference Soils of southwest Australia, extractable soil B was positively correlated with clay content and pH, negatively with sand content but not with organic matter levels. This suggests that low clay content (< 10%) and low pH (< 5 in $CaCl_2$) are useful predictors of low soil B status.

Boron fertiliser increased growth and seed set in canola on four low B soils from the northern sandplains (Table 1). These soils are acid sandy soils and were formed on sandstone rather than granitic parent rocks. In lupins, B increased pod set only on the MRA 5 soil from east of Dandaragan. In lupin, seed viability was about as sensitive to low soil B as seed yield. Decreases in seed viability can be expected when seed B is < 12 mg/kg, and especially at < 6 mg/kg. The symptoms of B deficiency observed on pods may be a useful field guide to the probability of harvesting lupin seed which is low enough in B to impair seed viability. In canola, seed yield was more sensitive to low soil B than in lupin. However, at marginal B levels in the soil, seed harvested may have decreased germination and vigour. The critical seed B levels for viability and vigour of canola could not be defined with the data available.

In the 2000 field experiments, no seed yield increases from B fertiliser application were recorded in either lupin or canola. However, canola yields were very low at Corrigin and Yuna due to low growing season rainfall. Yields of lupin were reasonable at Yuna due to early sowing and Moora, but there was no positive effect of adding B fertiliser. In 2001, canola yields were higher but still no positive responses to foliar or soil applied B fertiliser were found. Indeed at three sites, adding 5 or 10 kg borax/ha at sowing depressed seed yield, mostly by decreasing plant density.

Table 1. Properties of soils on which B application increased growth or seed set in canola in pots

Soil code	Soil type	pH ($CaCl_2$)	Sand (%)	Clay (%)	Soil B (mg/kg)	Parent material
GTN 05	Siliceous sand Uc 5.11	5.1	90	7	0.5	sandstone
MRA 05	Siliceous sand Uc 4.21	4.5	99	1	0.1	sandstone
MRA 08	Yellow duplex Dy 4.51	4.6	98	1	0.1	sandstone
MRA 09	Siliceous sand Uc 5.11	5.2	92	6	0.2	sandstone

Table 2. Yield, soil B (0-10 cm) and leaf B concentrations (at budding) in canola and lupin crops with B fertiliser (B 0) and significant B responses to B fertiliser in field experiments in 2000 and 2001. *B tox indicates that yield was depressed by B toxicity at 5-10 kg borax/ha

	B 0 yield (t/ha)	B response	Soil B (mg/kg)	Leaf B (mg/kg)		B 0 yield (t/ha)	B response	Soil B (mg/kg)	Leaf B (mg/kg)
Canola 2000					**Lupin 2000**				
Yuna	0.77	ns	0.5	25	Yuna	2.15	*B tox	0.2	25
Corrigin	0.38	ns	0.7	27	Dandaragan	1.89	ns	0.4	23
					Dandaragan	1.50	ns	0.3	21
Canola 2001					**Lupin 2001**				
Moora	1.07	ns	0.3	-	Yuna	0.98	*B tox	0.3	24
Narrogin	0.81	ns	0.5	-	Watheroo	0.64	ns	0.3	19
Katanning	0.88	ns	0.6	-					
Munglinup	1.45	ns	0.5	-					
Esperance	2.00	ns	0.6	-					
Corrigin	0.69	ns	0.5	-					
Yuna	1.36	*B tox	0.5	-					

CONCLUSIONS

Our results confirm that the risk of B deficiency cannot be discounted but field evidence suggests it is not severe in any of the areas studied. The areas most at risk have sandy, acid soils and occur on the sandplains of the Dandaragan Plateau, stretching from West Midlands to the Eradu sandplains.

No general recommendations for the use of B fertiliser on lupin and canola are warranted at this stage. However, farmers should remain vigilant for B deficiency symptoms especially on sensitive crops (canola, lucerne, chickpea); request soil and plant tests for B if concerned about B deficiency risk; and act on this information plus the advice of their local agronomist.

Soil or foliar B applications can be used to treat B deficiency. Foliar application is rapid acting but the correct timing of the application is important. Solutions of 1% (w/v) solubor (containing 21% B) are commonly used. Soil applications generally last longer although B may be leached from acid sandy soils and this may reduce the effectiveness of B fertiliser. Rates of B application should be < 5 kg of borax/ha on sandy soils to prevent the risk of B toxicity.

KEY WORDS

boron, deficiency, sandy acid soils, seed set, seed viability, soil analysis, toxicity

REFERENCES

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