Monitor crops closely for signs of low boron

The risks of trace element deficiencies such as boron are increasing in cropping soils due to higher grain production demands. CSIRO Land and Water researcher Mike Wong teamed up with Murdoch University’s Richard Bell to map areas in the Western Australian wheatbelt at risk of boron deficiency. This article details their findings.

Regular crop monitoring and targeted fertiliser application will enhance crop yields and reduce the risks of trace element deficiencies such as boron.

The continued removal of boron from soils during harvest is putting pressure on already depleted soil boron reserves.

As the area sown to legumes and canola expands and crop yields increase, the risk of boron deficiency becomes more important due to higher nutrient demands for crop production.

The risks of deficiency are increased in acid, sandy soils, such as those commonly found in Western Australia.

Previous studies suggest acid, sandy soils in areas of eastern Australia such as the tablelands west of the Great Dividing Range in New South Wales also could have a boron deficiency risk.

Benefits of boron

Boron is an essential trace element for flower development, seed set and seed quality. Boron is required in higher amounts for reproductive development of plants than vegetative growth.

Boron deficiency at critical stages of reproductive development can restrict fertilisation or cause pod abortion or poor seed set or seed growth. In extreme cases, crops on low boron soils grow well until flowering when floral abortion or seed set failure can result in severe yield losses.

But despite the potential risks, little boron is used as a fertiliser. Most farmers have only considered the possibility of boron toxicity and have not considered the possibility of boron deficiency.

Soil and tissue tests and glasshouse experiments have already shown cases of boron deficiency in WA.

In soils, boron concentrations of less than 0.5 milligrams per kilogram of soil would be considered marginal, with less than 0.3mg/kg at risk of boron deficiency, particularly when there is lush vegetative growth before flowering or when surface soils dry during the main flowering and pod and seed setting period.

In canola, boron concentrations of less than 30mg/kg in the youngest open leaf and less than 25mg/kg in the youngest mature leaf could benefit from boron application.

In lupin crops, boron concentrations less than 16mg/kg would be considered at risk of boron deficiency.

Mapping areas at risk

In a collaborative project between CSIRO Land and Water and Murdoch University, scientists used a method known as ‘weight of evidence’ modelling to determine where boron deficiencies could occur in WA.

The model uses all available evidence including geology maps, soil types and information gathered from a range of laboratory trials and paddock observations.

Preliminary research showed that soil boron levels were marginal in sandy, acid soils, particularly soils developed on sandstone parent materials.

At a glance

- The continued removal of boron from soils during crop harvest is putting pressure on soil boron reserves and increasing the risk of boron deficiency.
- Boron is essential for flower development, seed set and quality. A boron deficiency at crop flowering can result in seed set failure and significant yield losses.
- Regular crop monitoring and targeted fertiliser applications will reduce boron deficiency risks.
Extractable soil boron was positively correlated with clay content and pH, negatively correlated with sand content but not related to organic matter levels.

This indicated that low clay content (less than 10%) and low pH (less than five in CaCl₂) could be useful predictors of low soil boron status.

**Risk factors**

A boron deficiency risk map was prepared for the WA wheatbelt based on four main risk factors for which spatial data sets were available.

**Subsoil pH** — There is a strong correlation between boron availability and high subsoil pH values. This layer of evidence identifies areas with potentially excessive boron levels.

**Geology** — This layer of evidence is based on the influence of sandstone, and felsic (granitic and gneissic) parent materials on boron availability.

**Clay** — The range of topsoil clay content is narrow but a clay content of more than 20% indicates a high likelihood of sufficient boron.

**Topsoil pH** — The range of topsoil pH is narrow and is only weakly correlated with boron deficiency. But a pH of less than five (in CaCl₂) indicates increased likelihood of boron deficiency.

The layers of evidence are shown in Figure 1 (page 43).

The weight of evidence model used these layers of evidence, together with previous knowledge, to identify areas in the WA wheatbelt believed to be potentially at risk of boron deficiency (see Figure 2).

The mapping project showed 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.

In other areas of Australia coarse textured acidic soils developed on sandstones could be at risk of boron deficiency.

**Treating a boron deficiency**

Farmers are encouraged to regularly monitor their crops for symptoms of boron deficiency, particularly in areas believed to be at risk.

In canola, boron deficiency at the vegetative rosette stage is expressed by stunted growth, darker older leaves and smaller young leaves. Pods may be aborted or contain only a few seeds.

In lupin, boron deficiency also results in reduced pod sets. The pods exude a gummy substance at ripening and dry out in a darker colour.

When early season rainfall allows vigorous vegetative growth there also could be an increased risk of boron deficiency during flowering.

If a boron deficiency is suspected carry out soil and tissue tests and discuss the results with an adviser to confirm the deficiency.

**Soil and foliar applications**

Soil or foliar boron applications can be used to treat boron deficiency.

Foliar application is rapid acting but the correct timing of the application at budding to early flowering is important. Solutions of up to 1% (weight/volume) solubor (soluble boron fertiliser containing 21% boron) are commonly used.

Soil applications as part of a general fertiliser application at sowing generally last longer.

Take care to avoid excess boron (more than 0.5kg/ha of boron in sandy soils), which can cause toxicity. But boron can be leached from acid sandy soils and this will reduce the effectiveness of boron fertiliser.

**Acknowledgement:** Grains Research and Development Corporation. For more information contact Mike Wong, CSIRO Land and Water, by email on Mike.Wong@csiro.au, phone (08) 9333 6299 or fax (08) 9187 8211 or Richard Bell, Murdoch University, by email on rbell@central.murdoch.edu.au, phone (08) 9360 2370 or fax (08) 9310 4997.