To help increase confidence in soil testing, more than 5000 soil test–crop response results from across Australia have been compiled by the Making Better Fertiliser Decisions for Cropping Systems in Australia (BFDC) project.

The BFDC National Database includes all available trials for nitrogen (N), phosphorus (P), potassium (K) and sulphur (S) use in cereal, oilseed and pulse crops.

The online BFDC Interrogator has been built to enable members of the grains and fertiliser industries to develop soil test–crop response calibrations and critical soil test values for different crops.

Registered access to the BFDC Interrogator is available after successful completion of a BFDC training workshop.

CASE STUDY: *Sulphur in canola*

Fertilisers can contribute more than 20% of variable costs to broadacre grain production. Despite these costs, there tends to be a low level of confidence in soil testing to underpin fertiliser decisions on farms.

**CASE STUDY SITUATION**

- An agronomist wants to check the estimated critical $\text{KCl}_{0.01} S$ (0–10 cm) for canola with a yield potential >1 t/ha.

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IDENTIFYING SOIL TEST-CROP RESPONSE TRIALS

The BFDC Interrogator enables users to select from all of the national trials (locations shown as grey dots on the map in Figure 1).

For this case study, the user first selects ‘S’, ‘oilseed canola’, ‘dryland’, ‘winter’ and ‘All’ soils to give a large data set. This means that the list of possible trials is not narrowed at the start of interrogation.

On the Soil test-crop response trials page (see Figure 1), the following options were selected: Nutrient — ‘S’, Farming System — ‘dryland’, From Year — ‘All’, To Year — ‘All’, State — ‘All’, Season — ‘winter’, Crop — ‘oilseed canola’ and Australian Soil Class — ‘All’. The user then clicks on the ‘Select trials that satisfy the selection criteria above’ option.

Figure 1. Soil test-crop response trials
SOIL TEST-CROP RESPONSE CALIBRATIONS

The screen changes to the **Soil test-crop response calibrations** page (see Figure 2, page 4), where the selection of trials is refined and soil test-crop response criteria are derived. The map of Australia now shows the location of all 152 initially selected trials (shown as coloured dots).

**Note:** The points highlighted on the map in Figure 2 are soils where sulphur soil test data exist for experiments on canola and cover a full range of grain yields. Users can then select a filter to identify trials with specific grain yields.

On the **Soil test-crop response calibrations** page (see Figure 2, page 4), the following options were selected: ‘Choose soil test and sample depth’ — select ‘S KCl40 extractable mg/kg’ and ‘0–10 cm’. ‘Relative Yield’ was the default selection under ‘Graph soil test values by’.

Scroll down and select ‘Maximum yield above 1 t/ha’. This filter will eliminate lower-yielding trials from the selected data set. Click on ‘View data relationship’ to obtain a calibration. Initially select the ‘Tabulate data’ option.

In this case study the ‘grain yield’ filter option has been used.

The percentage relative yield ($\%\ Ry$) is the yield at no fertiliser ($Y_0$) expressed as a percentage of the maximum yield ($Y_{\text{max}}$) obtained for a trial with fertiliser application ($\frac{Y_0}{Y_{\text{max}}} \times 100$).

(Continued page 4)
Figure 2. Soil test-crop response calibrations
The BFDC Interrogator presents a table of 121 treatment series for the selected data (see Figure 3), which meet the final criteria set on the previous page (121 treatment series) giving yield and soil test information. This is an alternative display of data.

Figure 3. Soil test-crop response data
CALIBRATION RELATIONSHIPS

A graph is plotted for the data selected, with soil test axis (x axis) and the relative yield axis (y axis), with each soil as a different colour (see Figure 4).

The BFDC Interrogator fits a calibration curve to the trial data selected. It also calculates the soil test concentrations at the 80, 90 and 95% RY with their 95% confidence limits for the fitted curve.

In this case study, the experimental results are graphed relating relative grain yield and KCl40 S test in the 0–10 cm soil layer. The plot shows that 121 treatment series met the selection criteria. However, the plot is compressed by an abnormally high value KCl40 S in one soil. In this instance, there was a site where free gypsum was present in a deeper soil layer.

Close this table page and return to the Soil test-crop response calibrations page. Select ‘Limit max soil test value’ and enter a meaningful soil test value, for example ‘50’. Again select ‘plot data by soil type’ (see Figure 2, page 4).

A treatment series is a response calibration data point. A trial may have one or more treatment series. For example, some trials may use different phosphorus fertilisers (for example, fluid vs granular), different tillage systems (for example, no-till vs multiple tillage), or different placements of phosphorus at a range of rates. This could give a number of crop responses to phosphorus (treatment series) for a single trial.

(Continued page 7)
This change has not deleted any sites (still 121 treatment series) as the very high value was in a subsoil and was not plotted in the graph, despite the long x axis. The line of best fit calculated a critical value of 7.7 mg/kg for KCl\textsubscript{40} S concentration, which was associated with 90% RY (range 7.1-8.2 mg/kg). This was identical to the critical value in Figure 4 (see page 6) presented initially as no data were deleted from the plot (refer to case study: *Potassium in wheat*).

The fit to the data was moderate as the ‘R’ correlation coefficient was 0.36.

Scrolling down the page shows details on the data and filters selected in the case study (see Figure 5).

Registered users of the BFDC Interrogator can only exclude specific trials from a calibration by using the filter options or by limiting the extent of the soil test axis to exclude excessively high (outlier) values of the soil test.

**Figure 5. Alternative calibration relationship**
DISPLAYING SUBSOIL CHARACTERISTICS IN DATA PLOT

The BFDC Interrogator enables soil test data from sub-soils to be displayed in the calibration graph. The user needs to return to the Soil test-crop response calibrations page.

Close this second calibration page (displayed as Figure 5, page 7), and return to the Soil test-crop response trials page.

Scroll down to the bottom of that page (see Figure 6). At the bottom of the data filters select ‘Subsoil depth (cm)’ and ‘20–30cm’. Also select ‘Soil test value’ and enter ‘7’. Click on ‘plot by subsoil nutrient level’.

Figure 6. Soil test-crop response calibrations (scrolled down)
The plot (see Figure 7) uses colour to describe the sulphur status of the 20–30 cm layer of soil. The sites with KCl$_{so4}$ S at or below 7 mg/kg are presented in red, and those above 7 mg/kg are presented in blue. It is clear that some soils with KCl$_{so4}$ S below the critical value of 7.7 mg/kg in the 0–10 cm depth, had higher values of sulphur in the 20–30 cm layer. These are the blue points <7 mg/kg in the 0–10 cm and with 100% Ry. In these soils, the sulphur concentration was low in soil surface, but there was sufficient sulphur in the deeper soil layer.

Inspection of the data showed that all 121 treatment series were from Western Australia.
CONCLUSION

The critical value of $\text{KCl}_{40} \text{ S}$ concentration in the 0–10 cm depth for canola was 7.7 mg/kg with a critical range of 7.1–8.2 mg/kg, despite some soils having higher $\text{KCl}_{40} \text{ S}$ at the 20–30 cm depth than at the 0–10 depth.

The relationship was moderate ($R = 0.36$). The selected data were all from WA.

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Disclaimer

This case study is an example of the use of the BFDC Interrogator obtained from trial data entered into the database before December 2011. The BFDC Interrogator does not provide a fertiliser recommendation and this example does not seek to interpret the calibration relationship. The case study demonstrates the scope of the database and how the data can be used. Contact your FERTCARE® Accredited Advisor if you would like more information.

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