



MAKING BETTER FERTILISER DECISIONS FOR CROPPING SYSTEMS IN AUSTRALIA

CASE STUDY: *Potassium in wheat*

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

- A researcher wishes to establish the critical K Colwell (0–10 cm depth) for wheat in Australia.



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* project (BFDC).

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.



Department of
Primary Industries



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 'K', 'cereal wheat' 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 — 'K', Farming System — 'dryland', From Year — 'All', To Year — 'All', State — 'All', Season — 'winter', Crop — 'cereal wheat' 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 trials

The database holds 5420 trial treatment series undertaken at 2593 sites. These consist of 1709 N, 2281 P, 356 K and 270 S trials.

Searching the database

Trial sites are plotted on the map as grey dots. Make a selection of trials based on the search criteria below and/or by drawing a polygon on the map around your region of interest. Always begin with a broad selection, then narrow the criteria to search the selection in more detail.

Nutrient: **K** Farming System: **dryland**

From Year: **All** To Year: **All**

State: **All** Season: **winter**

Crop: **cereal wheat**

Australian Soil Class: **All**

Select trials that satisfy the selection criteria above

Map tools: **Draw Polygon**

Optional Layers | Legend

☐ Road ☐ Vegetation ☐ Rainfall



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 208 currently selected trial sites (shown as coloured dots).

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

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 'K Colwell (mg/kg)' and '0-10 cm'. 'Relative Yield' was the default selection under 'Graph soil test values by'.

Limit the x axis in the plot by entering '1100' mg/kg (this eliminates a single very high soil test value). Scroll down and select 'Soil pHCaCl₂ below 5.5'. This filter will restrict trials to those on more acidic soils. The user then clicks on the 'plot data by soil type' option.

In this case study the 'soil pH' 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_{max}) obtained for a trial with fertiliser application $(Y_0 / Y_{max}) \times 100$.

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Figure 2. Soil test-crop response calibrations

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Soil test-crop response calibrations

208 K trials fit your initial selection criteria. Their locations with Australian Soil Classification(s) are plotted on the map.

You may wish to:

- list selection summary information
- map Australian Soil Classification
- map relative yields
- map maximum yields

To choose a new region draw a polygon and **refresh** the trial selection.

Graph soil test value by:

☒ Relative Yield ☐ Yield Increase

Choose soil test and sample depth:

K Colwell mg/kg (667)

0-10cm (232)

View data relationship:

- plot data by crop
- plot data by soil type
- tabulate data

Limit max soil test value: 1100 (enter max soil test value for the plot)

Refine your trial selection for determining a data relationship:

- Filter by rainfall, maximum yield, soil pH and/or soil organic carbon:

Above

Below

Growing season rainfall: mm mm

Maximum yield: t/ha t/ha

Soil pH_{CaCl2}:

Soil organic carbon: % %

- Filter by any of the trial characteristics below:

Soil texture:

Tillage system:

Phosphorus Buffering Index (PBI):

Last land use:

Crop stress rating:

Subsoil nutrient effect:

This filter is useful only for K and S trials where soil test data have been collected from multiple depths (e.g. 0-10cm, 10-20cm). Choose a surface soil sample depth and enter a suitable soil test (e.g. Colwell K) above. Below, choose a subsoil sample depth and a value for this soil test (e.g. 25 mg/kg) which represents an adequate nutrient level. Click the 'plot calibration' link below to show which surface samples have corresponding adequate or inadequate subsoil nutrient levels.

[clear] [undo] [complete]

Map tools: Draw Polygon

Optional Layers | Legend

☐ Road ☐ Vegetation ☐ Rainfall

A polygon can be drawn on the map when the 'Draw Polygon' tool is selected from the Map tools menu. When doing a trial selection, only those trials falling within the polygon will be selected. To draw the polygon, click on the map to define three or more points that form a boundary around the geographic area of interest. To complete the polygon, always click the '[complete]' text below the map. The polygon boundary must not cross over itself.



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 3).

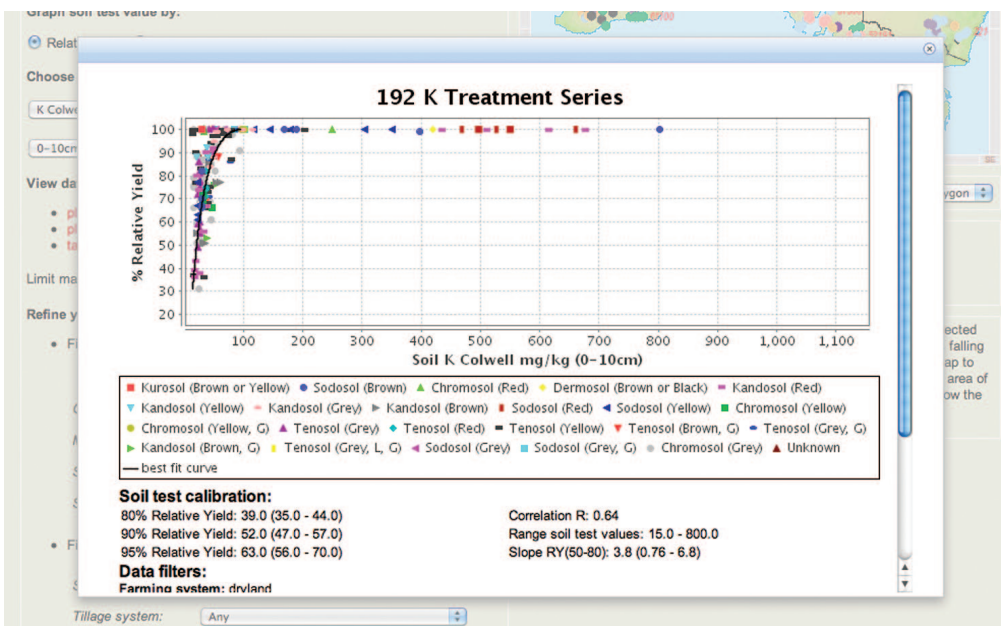
The *BFDC Interrogator* fits a calibration curve to the trial data selected. It also calculates the soil test concentrations at the 80, 90 and 95% RY with their 95% confidence limits for the fitted curve.

In this case study, the RY calibration plot shows that 192 treatment series met the revised selection criteria. However the range of the critical value for K Colwell is compressed by the much higher values of K Colwell in some soils, even though the length of the x axis has already been limited to 1100 mg/kg. These high K Colwell values leverage the line of best fit and give a false high critical value (52 mg/kg: range 47-57 mg/kg).

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.

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Figure 3. Calibration relationships

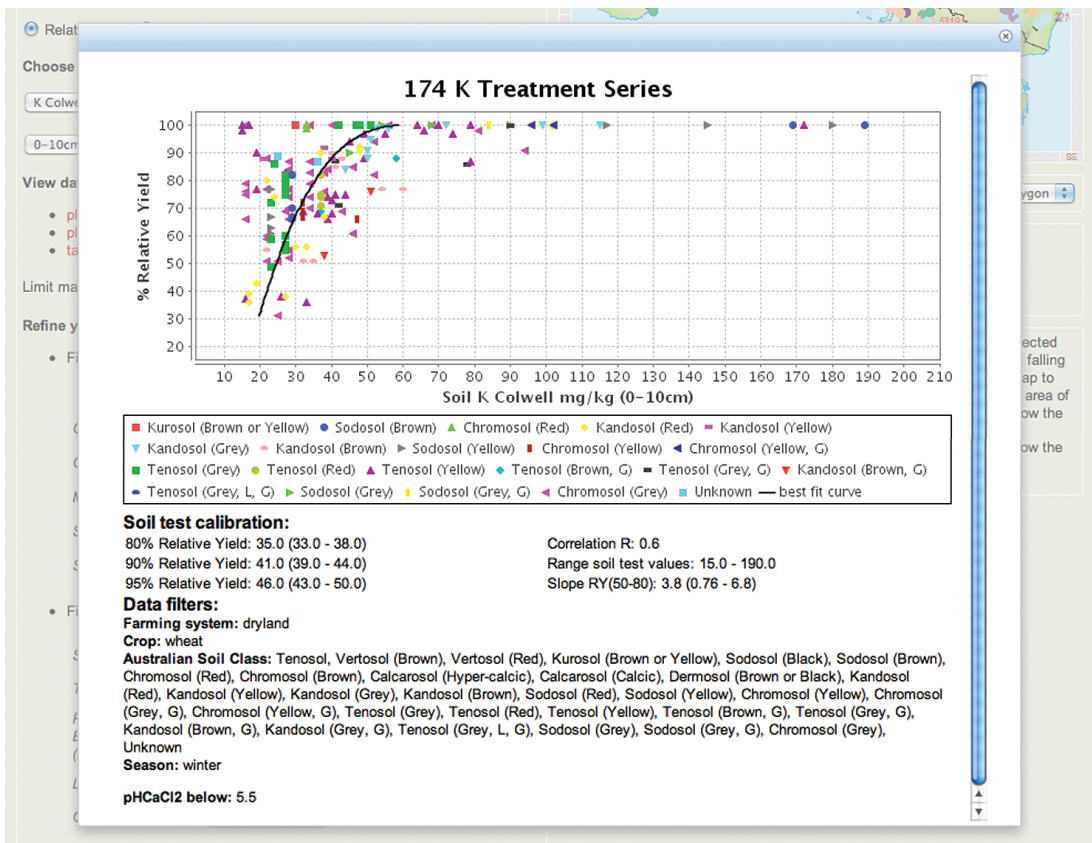


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Close this page and return to the [Soil test-crop response trials page](#). Select 'Limit max soil test value' and change from '1100' to '200'. Select 'plot data by soil type' again (see Figure 4).

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Figure 4. Alternative calibration relationships





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This change deleted the sites with highest leverage (174 treatment series now rather than 192). The line of best fit shows that a critical K Colwell concentration of 41 mg/kg was associated with 90% of maximum grain yield (range 39–44 mg/kg). This was a lower critical value than with the 192 treatment series (52 mg/kg; range 47–57 mg/kg). The fit to the data was *good* as the 'R' correlation coefficient was 0.60.

Scrolling down the page shows details on the data and filters selected in this case study.

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.

CONCLUSION

The critical value for K Colwell concentration in the 0–10 cm depth for wheat on more acidic soils was estimated at 41 mg/kg with range of 39–44 mg/kg.

The relationship was *good* ($R = 0.60$). Some data were eliminated by limiting the x axis and restricting critical K Colwell values to a maximum of 200 mg/kg.

Acknowledgements

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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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