



# MAKING BETTER FERTILISER DECISIONS FOR CROPPING SYSTEMS IN AUSTRALIA

## CASE STUDY: *Phosphorus 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 advisor wishes to examine the critical Colwell P test for soils (0–10 cm depth) for canola under reasonable seasonal conditions (grain yields >1 t/ha).



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  
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## IDENTIFYING SOIL TEST-CROP RESPONSE TRIALS

The *BFDC Interrogator* enables the 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 'phosphorus', 'oilseed canola' 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 — 'P', Farming System — 'All', 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 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: **P** Farming System: **All**

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

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

Crop: **oilseed canola**

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

**Note:** The points highlighted on the map in Figure 2 are soils where phosphorus 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 'P 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 '60' mg/kg (this eliminates a single very high soil test value). Scroll down and select 'Maximum yield above 1 t/ha'. This filter will eliminate lower-yielding trials from the selected data set. The user then clicks on the 'plot data by soil type' 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 ( $Y_{max}$ ) 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

50 P 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:

P Colwell mg/kg (109)

0-10cm (48)

View data relationship:

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

Limit max soil test value: 60 (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:	<input type="text"/> mm	<input type="text"/> mm
Maximum yield:	<input type="text"/> t/ha	<input type="text"/> t/ha
Soil pH <sub>CaCl2</sub> :	<input type="text"/>	<input type="text"/>
Soil organic carbon:	<input type="text"/> %	<input type="text"/> %

- Filter by any of the trial characteristics below:

Soil texture:

Tillage system:

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.

Subsoil depth (cm)  Soil test value  (enter a number)

- plot by subsoil nutrient level

[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 Australian Soil Class (ASC) shown as a different colour (see Figure 3).

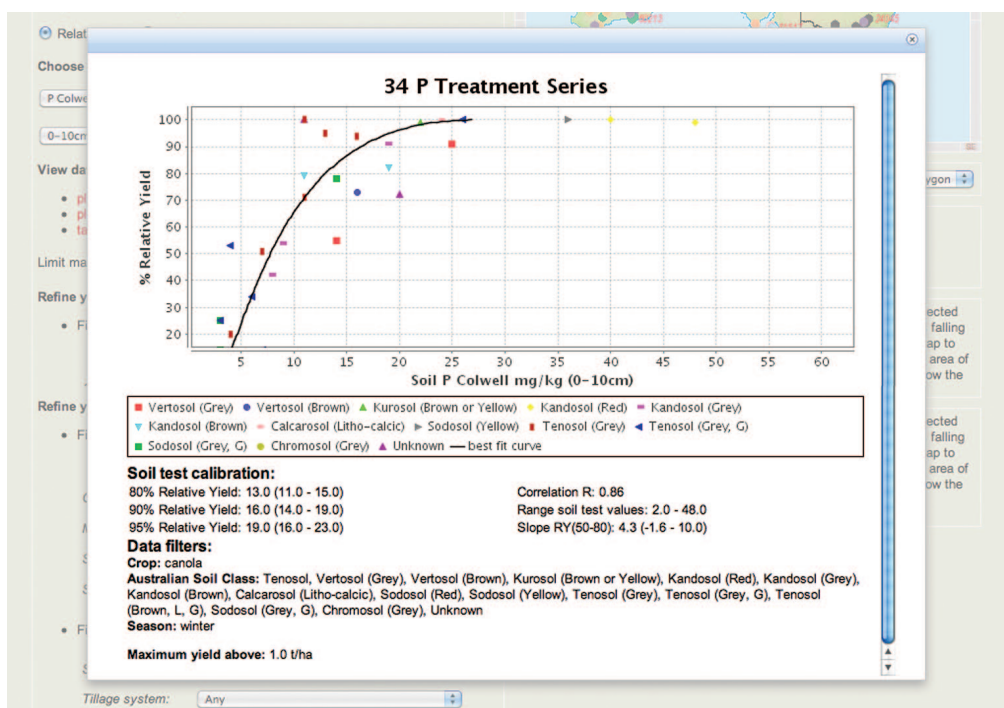
The *BFDC Interrogator* fits a calibration curve to the trial data selected. It also calculates the soil test concentrations at the 80, 90 and 95% RY with their 95% confidence limits for the fitted curve.

In this case study, the RY calibration plot shows that 34 treatment series met the revised selection criteria. Closer examination of the data set shows that 27 of the 34 treatment series were from Western Australia.

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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The calibration curve shows that a critical soil test concentration of 16 mg/kg Colwell P was associated with 90% RY. The critical range of Colwell P value was of 14–19 mg/kg (95% confidence limits). The fit to the data was *excellent* with an ‘R’ correlation coefficient of 0.86. A minimum ‘R’ value of 0.15 is required for a data set to be accepted. Scrolling downward shows details of the data and filters given in the 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. More information on the use of filters is given in the case study: **Potassium in wheat**.

## CONCLUSION

The critical value of Colwell P concentration in the 0–10 cm depth for canola was 16 mg/kg with range of 14–19 mg/kg.

The relationship was *excellent* ( $R = 0.86$ ). Some data were eliminated by limiting the x axis and restricting grain yield to a yield maximum of >1t/ha. The selected data were predominantly from WA.

## 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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