



MAKING BETTER FERTILISER DECISIONS FOR CROPPING SYSTEMS IN AUSTRALIA

CASE STUDY: *Nitrate-N in wheat on black vertosols in Queensland*

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 is checking the critical nitrate-N values determined in the 0–60 cm soil depth on black vertosols (black heavy cracking clay) in Queensland. This advisor is not interested in the lower-yielding trials; only trials with maximum grain yield of >2 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 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 'N', 'cereals wheat', 'QLD' and 'Vertosols (black)' and 'All' years.

On the **Soil test-crop response trials** page (see Figure 1), the following options were selected: Nutrient — 'N', Farming System — 'dryland', From Year — 'All', To Year — 'All', State — 'QLD', Season — 'winter', Crop — 'cereal wheat' and Australian Soil Class — 'Vertosol (Black)'. 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: **N** Farming System: **dryland**

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

State: **QLD** Season: **winter**

Crop: **cereal wheat**

Australian Soil Class: **Vertosol (Black)**

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. A map of part of Queensland now shows the location of all currently selected 192 trial sites (shown as coloured dots).

Note: The points highlighted on the map in Figure 2 are soils where nitrogen soil test data exist for experiments on wheat 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 'Nitrate N kg/ha' and '0-60 cm'. 'Relative Yield' was the default selection under 'Graph soil test values by'. Scroll down and select a 'Maximum yield above 2 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.

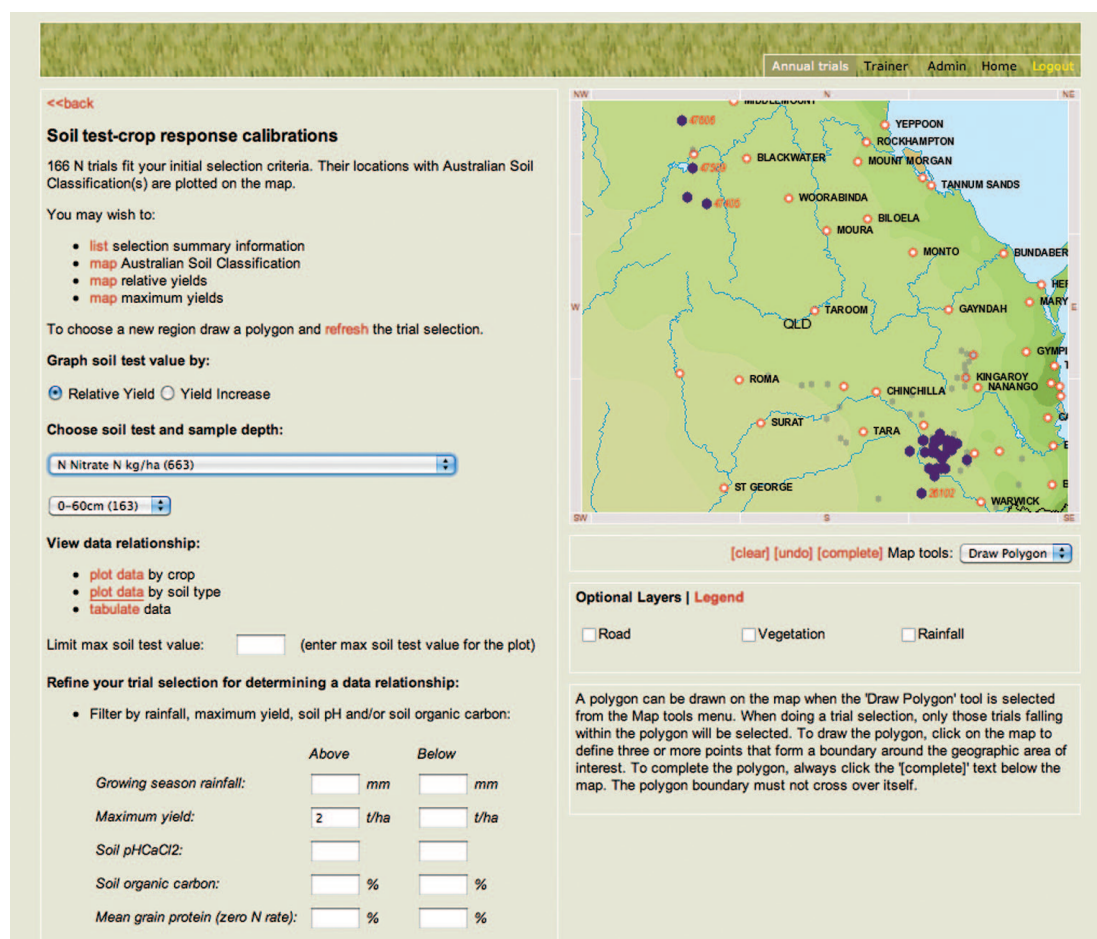
In this case study the 'grain yield' filter option has been used.

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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► (Continued from page 3)

Figure 2. Soil test-crop response calibrations



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. In this case study only one soil type is involved so only one symbol is presented on the graph (see Figure 3).

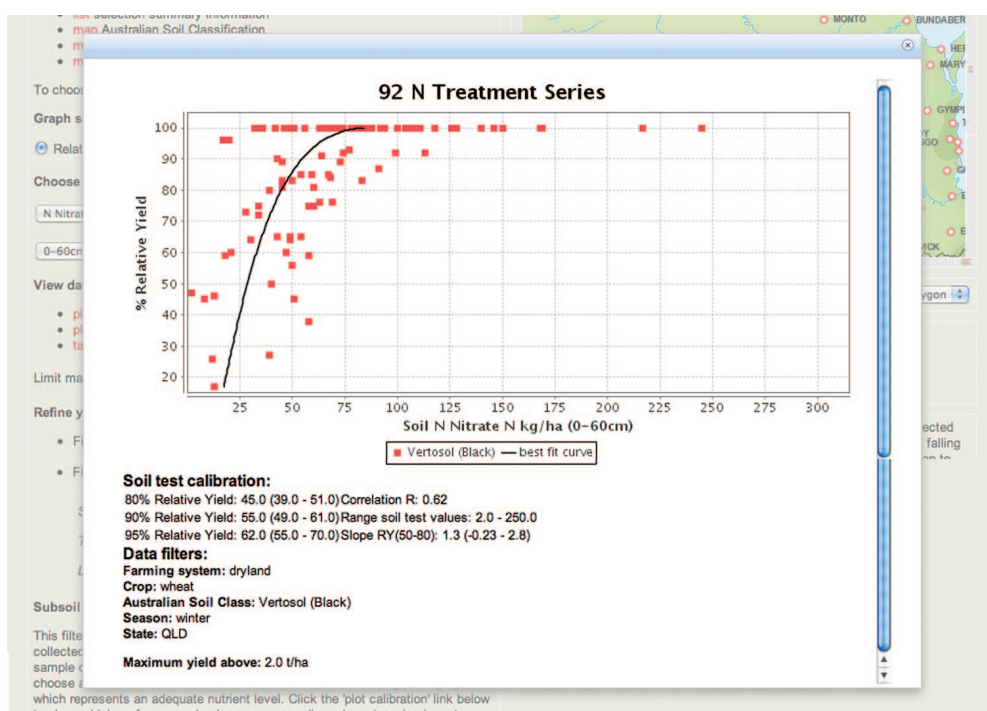
The *BFDC Interrogator* fits a calibration curve to the trial data selected. It also calculates the soil test concentrations at the 80, 90 and 95% RY with their 95% confidence limits for the fitted curve.

In this case study, the RY calibration plot shows that 92 treatment series met final selection criteria.

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.

The calibration curve shows that a critical soil test concentration of 55 kg/ha of nitrate-N was associated with 90% RY. The critical range was 49–61 kg/ha (90% confidence limits). The fit to the data was good as the 'R' correlation coefficient was 0.62. 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 selected in this case study.

Figure 3. Calibration relationships



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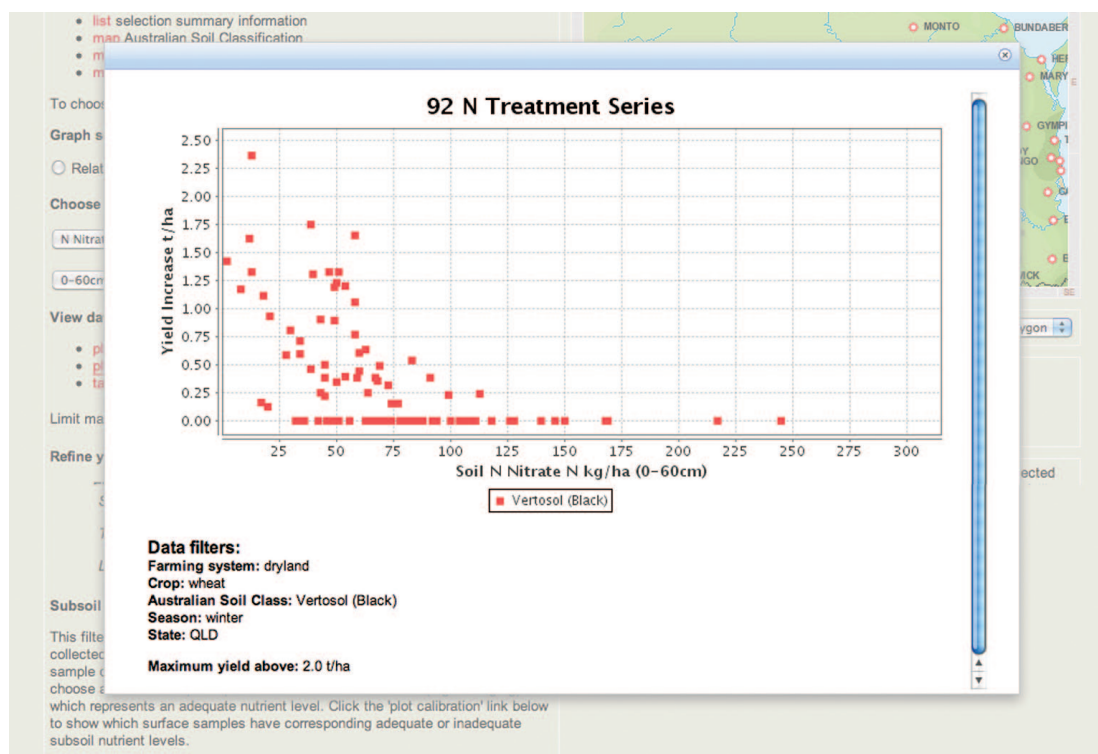
On inspection the data points appear to exist as two different relationships. One relationship has a critical value below 25 kg/ha with a series of values near 100% RY at soil nitrate-N of less than about 75 kg/ha; the other data points are consistent with a critical value of about 80 kg/ha. This may be due to seasonal factors, but would need further examination.

An alternative presentation of the data can be given by the *BFDC Interrogator*. Close the **Calibration** page and return to the **Soil test-crop response calibrations** page.

On the **Soil test-crop response trials** page, click on 'Yield increase' rather than 'Relative yield' button, and again select 'plot data by soil type'. A calibration curve cannot be obtained for the plot of yield increase.

A different plot is presented (see Figure 4). Absolute yield increase of grain (t/ha) is plotted against the soil nitrate-N (kg/ha). This plot is intended to assist in the economic interpretation of the data.

Figure 4. Alternative plot





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 nitrate-N concentration in the 0–60 cm depth for wheat was estimated to be 55 kg/ha with a critical range of 49–61 mg/kg.

The relationship was *good* ($R = 0.62$), despite an apparent separation of the data into two groups.

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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