POTATOES SOUTH AUSTRALIA
the voice of the potato industry value chain

Soil Phosphorus Availability by DGT

Key points

- Present soil testing methods for assessment of available phosphorus (P) have been shown to overestimate available P on certain soil types (calcareous, acidic with high iron or aluminium).
- The Diffusive gradients in thin-films (DGT) method has been established for assessment of available P in a wide range of Australian soils and measures available P at more relevant chemical and physical soil conditions.
- A database of DGT results with crop responses across southern Australia reveals a greater accuracy of available P measurement compared to Colwell P with or without Phosphorus Buffering Index (PBI) interpretation.
- DGT has potential to not only measure the available P status but also to predict P rates required to maximise yields in a deficient scenario.

Overview of DGT

Soil test	Advantages	Disadvantages
DGT	• Measures P at soil pH • No chemicals applied • More applicable soil moisture • Value needs no adjustment for other soil characteristics • Most accurate assessment of available P	• More labour intensive • Slightly more expensive • Sensitive to laboratory variability or contamination • Small amount of data for certain crop types
Conventional soil P tests	• Cheap • Large database of results • Available commercially • ASPAC certification available	• Measures P at set pH (e.g. 8.5) • Chemical applied to soil • Large soil dilution • Requires PBI measurement to improve interpretation

Figure 1: *Components of the DGT method including the iron oxide binding gel (orange) underneath a clear diffusive gel. A filter paper is placed on top (not shown).*

Figure 2: *Measurement of available P by DGT. The DGT device is placed upside down on a moist soil (~100 % water holding capacity) for a period of time (typically 20–24 hours).*

DGT has been developed for the assessment of available P in a wide range of soils. The mode of measurement is by diffusion of available P in the soil toward a P sink (an iron oxide gel) via a membrane which controls movement of P to the sink (Figure 1). The gel and protective filter paper are held securely in a plastic piston device. This is deployed on moist soil (Figure 2) for around 24 hours after which the device is washed, and the amount of P bound to the gel is then measured.

Therefore the DGT measurement incorporates the initial soil solution P concentration and also the ability of the soil to resupply the soil solution pool in response to the removal of P, mimicking the action of plant roots better than conventional methods (table 1).

DGT critical values have successfully been determined from field trials across southern Australia for wheat, barley, canola and field pea crops.

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Innovative nutrient management for the Australian potato industry

Project Aim

The aim of the 'Innovative nutrient management for the Australian potato industry' project was to determine if the DGT method can more reliably predict potato tuber yield responses to applied phosphorous (P) fertiliser than the commonly used soil P tests.

Funded by the Federal Government Department of Agriculture and Water Resources through the Landcare Innovation Grants scheme and delivered in collaboration between Potatoes South Australia, Primary Industries and Regions SA, the University of Adelaide and the South Australian Potato Industry, the research is the first of its kind in Australia for a horticultural crop.

Method

The DGT technology was tested by conducting 15 replicated yield response trials across all of the major South Australian potato growing regions, encompassing a wide range of soil and potato types. Minimum and maximum tuber yields were determined and yield penalty to no applied P fertiliser was expressed in relation to:($[Y_{0P}/Y_{max}]$x100) and is referred to herein as Relative Yield % (RY%).

Starting soil P status was assessed using the common Colwell, Olsen and Bray2 extraction methods in addition to the DGT-P test.

RY% was plotted against soil P concentration as measured by each extraction method and response curves fitted where appropriate.

Results from the research showed:

- The DGT test shows a strong relationship between DGT-P values and relative yield (Figure 1).
- The commonly used Colwell, Olsen and Bray2 soil P tests showed a poor correlation between measured soil P concentration and relative yield.
- Only four of the fifteen replicated trials were significantly responsive to applied P fertiliser (responsive sites, shown in blue on Figure 1); hence, eleven of the sites did not achieve significant increases in yield when P fertiliser was applied, owing to the high starting P status of the soil (non-responsive sites, shown in orange in Figure 1).
- P fertiliser application rates could be substantially reduced at over 7% of sites.
- Further research will help to refine the critical range and enable the identification of sustainable P application rates for different soil types.

How to interpret DGT values for potatoes

Trial results to date indicate that the critical DGT-P value required to obtain >90% relative yield is 171 µg/L; with a 95% confidence interval fitted to this value, the critical range is 75 - 310 µg/L (Figure 1).

- DGT-P values <75 µg/L indicate that moderate to substantial yield penalties would occur if no P fertiliser were applied.
- Potato crops grown in soils with DGT-P values between 75 and 310 µg/L have a moderate likelihood of achieving a small yield increase when P fertiliser is applied.
- DGT values >310 µg/L indicate a very low likelihood of achieving a yield increase when P fertiliser is applied

Whilst the trials were conducted in South Australia, the results and critical values are relevant nationally.

For full project details and to interpret your DGT results visit: www.dgtpotatoes.com.au

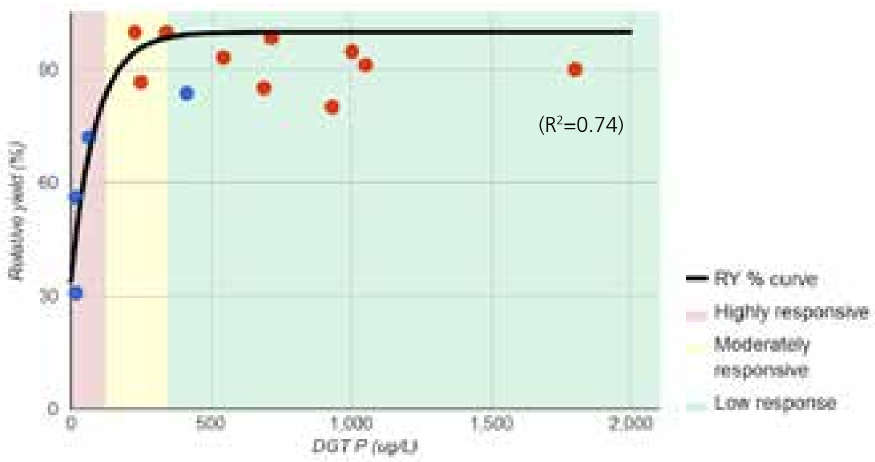

Figure 1: *Relationship between DGT values and potato response (relative yield).*

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