

## Fluid Fertiliser Research



CSIRO Land and Water leads collaborative research examining the behaviour and agronomic effectiveness of fluid fertilisers in alkaline soils, together with the South Australian Research and Development Institute (SARDI), Victorian Department of Primary Industries and the University of Adelaide. The project is funded by the Grains Research and Development Corporation (GRDC).

**Fluid phosphorus fertilisers are showing promise on the calcareous soils of Eyre Peninsula, South Australia, where soil chemical reactions frequently bind granular phosphorus and render it unavailable for plant use. But what of non-calcareous, alkaline and acid soils? CSIRO researchers have begun to investigate the impact of fluid phosphorus on a range of soil types.**

Early results suggest fluid phosphorus fertilisers could provide yield benefits over granular products on soils other

than calcareous types. But more research is needed to gain a better idea of the cropping benefits of fluid versus granular phosphorus, especially on acidic soils.

Wheat grown on sodosol and calcarosol soils from the Victorian Mallee treated with the fluid fertilisers ammonium polyphosphate

and phosphoric acid produced more dry matter than plants fertilised with granular phosphorus (see Table 1).

There are also indications that fluid phosphorus could be superior to granular products under some circumstances on vertosol soils from the Wimmera, Victoria, district.

Table 1. Dry matter yield of wheat grown under glasshouse conditions.

Soil type	Sample number	pH (water)	No phosphorus	APP	H <sub>3</sub> PO <sub>4</sub>	Triple super
(wheat yield g/pot)						
Wimmera (vertosols)	7	8.2	1.03	1.67	1.69	1.44
Birchip (sodosols; calcarosols)	3	6.8	1.36	1.71	1.80	1.55
Northern Mallee (calcarosols)	4	8.0	0.71	1.31	1.38	1.03
South Australia (grey calcareous)	10	8.5	0.45	0.86	0.86	0.51
Acid soils (Victoria and South Australia)	5	5.8	0.49	1.33	1.28	1.12

## Fertiliser rendered unavailable

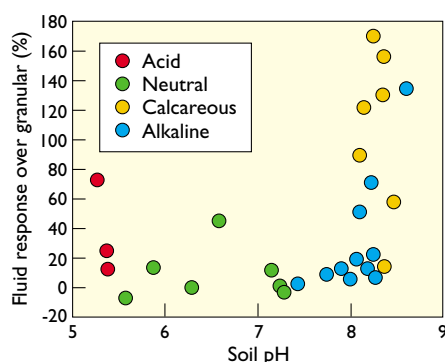
Calcareous and acid soils are widespread across Australia and are commonly used for cereal production. But these soils present challenges for crop phosphorus nutrition because they can bind granular fertiliser phosphorus into forms unavailable for plant use.

Researchers from CSIRO, the University of Adelaide, the Victorian Department of Primary Industries and the South Australian Research and Development Institute compared wheat growth response to fertiliser type on a range of Australian cropping soils.

The fertilisers tested were triple-superphosphate, phosphoric acid, ammonium polyphosphate and a control of no phosphorus fertiliser. The amount of phosphorus applied to each pot was equivalent to 12 kilograms of phosphorus per hectare with nitrogen and trace elements added for balanced nutrition.

Wheat responded to phosphorus application on 70 per cent of the soils tested (see Table 1). In about 60% of soils, wheat plants grew significantly more when fluid fertilisers rather than granular fertilisers were used.

Soil pH and calcium carbonate content were the key soil properties



controlling crop response to the fluid phosphorus fertilisers. Wheat grown on soils with high levels of calcium carbonate (free lime) responded best to fluid fertilisers. Surprisingly, fluid fertilisers also performed well on some acidic soils (see Figure 1).

## Fluid phosphorus more available

Researchers suspect crops find it easier to access phosphorus from fluid fertilisers rather than granular products on some soils. For example, on calcareous soils supplied with granular triple superphosphate, the amount of plant tissue phosphorus was below the critical phosphorus deficiency limit. But when the same amount of phosphorus was applied in fluid form, plant growth increased by more than 40%.

In contrast, neutral pH soils do not fix phosphorus as strongly as alkaline and acidic soils and fluid fertilisers therefore do not seem to offer a benefit over granular fertilisers on neutral soils.

## Soil chemistry binds phosphorus

In calcareous soils, chemical reactions occur around phosphorus granules, which render much of the granular phosphorus unavailable for plant use. For example, when granular phosphorus fertilisers are applied to grey or red calcareous soils, 10–20% of the total phosphorus remains precipitated within the granules after five weeks and is therefore inaccessible to plant roots.

Granular fertiliser which dissolves and diffuses out of the granules quickly forms less soluble products



Shoot response of wheat to fluid fertilisers (APP and H<sub>3</sub>PO<sub>4</sub>) compared to granular fertiliser (Triple P) and a control growing on a Vertosol collected from Minyip in the Wimmera under glasshouse conditions.

(compared with fluid fertilisers) in the area immediately next to the granule. In contrast, fluid fertilisers progressively diffuse away from where they are placed within the soil, creating a larger volume of soil with elevated and available phosphorus levels and increasing the likelihood of roots coming into contact with the phosphorus.

An interesting finding from the research indicates ammonium polyphosphate could possibly mobilise soil phosphorus which has been previously rendered unavailable for plant use. This means the fluid fertiliser could supply not only more plant-available phosphorus but also could solubilise some of the fixed phosphorus held within these soils and potentially reduce the amount of phosphorus application required.

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