



# Sydney Environmental & Soil Laboratory

Specialists in Soil Chemistry, Agronomy and Contamination Assessments

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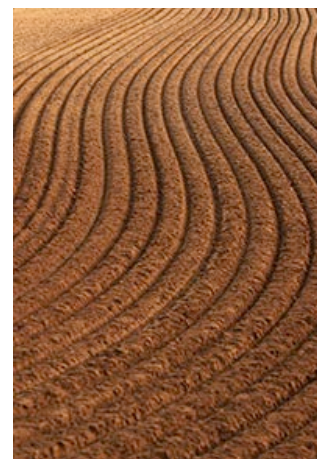
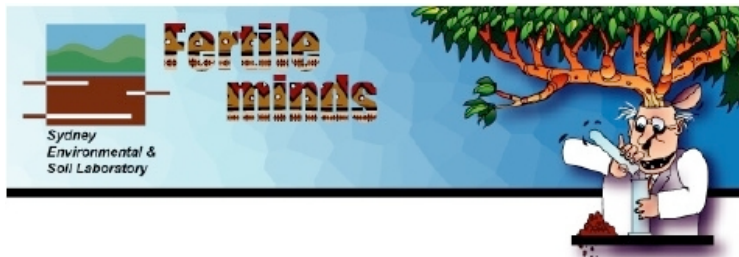
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## A LOOMING PHOSPHORUS CRISIS

We've all heard of "peak oil": the situation in which half of all oil reserves have already been extracted and used, and prices will henceforth go up. But of far more concern for agriculture is "peak phosphorus". Unlike oil, for which substitutes are available, there is no substitute for phosphorus (P). And we're slowly running out.

P is one of several essential elements for all life. As an element, it cannot be manufactured, only extracted. Unlike nitrogen, which can be pulled from the atmosphere (either by factories or by legumes), economically extractable P is found in only a dozen countries, 5 of which produce 75% of world output: Morocco (with around half of all reserves, much of it in occupied Western Sahara), China, the USA and Russia.

According to research cited by the [Global Phosphorus Research Initiative \(GPRI\)](#), current high-grade reserves will be depleted within 50 to 100 years, and P production could peak by 2030. Prices are already increasing quickly: the price of rock phosphate increased from US\$50/t in 2007 to US\$350/t in 2008 (a factor of 7 times, or a 600% increase).

P occurs in nature in very insoluble forms commonly called rock phosphate (apatite). This P is not readily available to plants, and rock phosphate has to be chemically treated to render it soluble. Even so, when applied to soil, it is chemically locked up again or "fixed" in the soil, making it less available to plants, so more fertiliser must be added, usually just before planting.

P in wastewater can be removed in sludge (biosolids) and reapplied to farmland, yet most sludge around the world is landfilled, burned or poured out to sea. (Of all the P mined since 1950, about a quarter is now lost to landfill and waterways.) This is a one-way trip, necessitating the mining of further raw materials. P is recycled on geological timescales by sedimentation, uplift and weathering, but this takes millions of years, so it is effectively lost to our agricultural economy. About 10% of P is used in manufacturing. The rest - 90% - is used in agriculture. As the high-grade reserves continue to be depleted, the cost of P, and hence the cost of food, will rise.

### SO WHAT CAN BE DONE?

- At the regional or national level, we must recycle P in waste such as sewage and garbage back onto the land. According to studies cited by the GPRI, the P content of faeces and urine, if recycled 100% back to the land, can supply all P needs for food production.
- At the international level, we can help developing countries by subsidising P fertiliser and wastewater recycling schemes (sewage treatment), and at the same time reduce disease and deaths due to unclean water.
- At all levels we can look for opportunities to reduce P in the waste stream, from mining to food consumption, and so close the loop on P loss from our economy.
- At the farm level, the efficiency of P use can often be improved, by making sure the plants get what is applied before it is fixed in the soil.

In fact, there are good economic reasons not to apply too much P.

We have established over the past 25 years that the critical P level (Bray P1 extract) is 20 mg P/kg. The following table explains:

Bray P soil test level (mg P/kg)	Range	Probability of a response to P fertiliser application (%)
<6	Very low	85-100
6-12	Low	60-85
13-20	Moderate	30-60
21-30	High	10-30
>30	Very high	0-10

The table indicates that if your soil has a P value of <6 mg/kg (very low), then there is a very high probability that the plants will respond to P fertiliser. Conversely, if the level is >30 mg/kg (very high), there is virtually no chance that plants will respond to more P.

We frequently see P levels well above 30 mg/kg, and in many urban and sports turf situations we see levels of several

hundred mg P/kg (and in some cases over 1000 mg P/kg). In these situations there is no valid reason to apply more P, yet people continue to do so.

There can be several reasons not to apply additional P:

- To avoid P phytotoxicity (all plant species have an upper limit to the amount of P that they will tolerate). In urban areas, P toxicity is far more common than P deficiency. P deficiency will not kill a plant, whereas P toxicity will.
- To prevent P contamination of the environment. Excessive P will leave the soil profile and end up in ground water or surface water. This P pollution is associated with algal blooms, fish kills, and the spread of exotic weeds in bushland and along creek lines.
- If the soil test P level is >30 mg/kg, there is no economical rationale for the application of more P. You are wasting your money.
- P is a limited resource, and we should be acting now to responsibly preserve P resources for future generations.

#### **FURTHER READING**

Global Phosphorus Research Initiative: <http://phosphorusfutures.net/>.

Cawood M. 2010. Peak phosphorous [sic]: mankind's latest threat. *Stock & Land*.

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