



# SOIL PHOSPHORUS - THE BASICS

## SOIL PHOSPHORUS

Phosphorus (P) is a major element (macronutrient) that plays a number of important roles in plants, such as productivity, crop quality, increased root growth, and earlier crop maturity. It is necessary for proper cell division and formation of new cells.

It's important that soil P is managed correctly for crop nutrition.

This factsheet covers the common characteristics of soil P and its availability for uptake by plants such as pH, mobility and microbial activity, and provides practical management tips and tools in line with the '4Rs' - *right source at the right rate, right time, right place*.

Characteristic of soil P and its availability for uptake by plants	How to manage soil P for crop nutrition	Specific / detailed considerations
<p><b>P availability for uptake is pH dependent.</b> P is most available for plants when pH is between 6 and 7</p>	<ul style="list-style-type: none"> <li>Maintain optimum soil pH.</li> </ul> <p><b>RIGHT SOURCE*</b></p>	<ul style="list-style-type: none"> <li>Maintain soil pH between 6 and 7.</li> <li>Apply lime if required.</li> <li>Use acidifying fertilisers in alkaline soils – but only if the alkalinity is NOT due to sodicity.</li> <li>When selecting fertilisers (e.g. N fertilisers), consider those that are the least acidifying, unless soil pH is &gt;7.</li> </ul>

\*from International Plant Nutrition Institute (IPNI) 4R Nutrient Stewardship

"Right source @ right rate, right time, right place"

[www.ipni.net](http://www.ipni.net); [www.ipni.net](http://www.ipni.net) - global framework

[anz.ipni.net](http://anz.ipni.net) - for Australia and New Zealand

Characteristic of soil P and its availability for uptake by plants	How to manage soil P for crop nutrition	Specific / detailed considerations
<p><b>Soil P is not always available to plants.</b> It can quickly become adsorbed or fixed. The ability of a soil to adsorb P depends on soil texture, pH, soil condition and levels of Fe, Al (low pH soils), Ca and Na (high pH soils), all of which can form insoluble phosphates.</p>	<ul style="list-style-type: none"> <li>• Use soil tests and plant tissue or sap analysis to check P uptake.</li> <li>• Soil can get low in P.</li> <li>• If availability is high, there is a risk of loss, e.g. via leaching and run-off (leaching is more likely in sandy soils, run-off occurs with hill slope erosion).</li> <li>• High P applications rates can induce zinc (Zn) deficiency.</li> </ul> <p><b>RIGHT RATE</b></p>	<ul style="list-style-type: none"> <li>• Soil P (from soil test) can include both available and unavailable P depending on the test (e.g. Colwell, Bray, Olsen, Mehlich, DGT). Monitor P over time to ensure soil P is not getting run down.</li> <li>• Consider P fixing indicators such as Phosphorus Buffering Index (PBI) or P-saturation Ratio (M3-PSR) from soil tests. If PBI is high, or PSR is low, a larger amount of fertiliser is required in order to increase potentially available soil P than for low P-fixing soils. It is difficult to supply enough P when the pH is very low or soils are high in calcium or sodium. Therefore, consider PBI in conjunction with soil P level, pH and CEC, especially exchangeable calcium and sodium.</li> <li>• Use crop removal estimates when developing a crop nutrition program. For P fertiliser rates, P inputs need to be up to 10 times higher than removal, depending on the level of 'available' P and P fixing index.</li> <li>• If high rates of P are applied, zinc (Zn) uptake can be reduced, resulting in Zn deficiency.</li> <li>• Different soil P tests (e.g. Colwell, Bray, Olsen, Mehlich, DGT) usually do not correlate, especially in P fixing soils or if the pH is high or low - so it is generally not possible to convert one to another.</li> <li>• Use plant sap or tissue analysis to assess the crop nutrient status. Top up P via side dressing, fertigation or foliar applications, as required.</li> <li>• Divide non-uniform paddocks into smaller management units based on grid testing of soil or spatial data that provides information on management zones.</li> </ul>

Characteristic of soil P and its availability for uptake by plants	How to manage soil P for crop nutrition	Specific / detailed considerations
<p><b>Soil P is not always available to plants (continued).</b></p>	<ul style="list-style-type: none"> <li>• Soil applied P can become adsorbed to calcium in high pH soils or aluminium and iron on low pH soils very quickly.</li> <li>• Consider P fertiliser timing.</li> </ul> <p><b>RIGHT TIME &amp; RIGHT RATE</b></p>	<ul style="list-style-type: none"> <li>• If possible, apply P less than a week before when it is required, i.e. roots need access.</li> <li>• Never pre-spread P several weeks before the crops needs it, especially in P-fixing soils. In these soils, banding P below the root zone at planting may help with availability.</li> <li>• Watering-in of transplants with P in the water can have a positive effect on establishment and carry through to yield.</li> </ul>
<p><b>P moves very little in most soils.</b> Applied P may move only 2-3 cm from the place of application.</p>	<ul style="list-style-type: none"> <li>• Place P fertiliser where roots can access it.</li> </ul> <p><b>RIGHT PLACE</b></p>	<ul style="list-style-type: none"> <li>• Band P fertiliser in the root zone.</li> <li>• Incorporate P fertiliser rather than surface broadcast.</li> <li>• For seeded crops: <ul style="list-style-type: none"> <li>• Band P 5-8 cm from the seed at sowing.</li> <li>• For high P testing soils, only banded P is needed.</li> <li>• For low P testing soils, a portion of P fertiliser should be broadcast and incorporated.</li> </ul> </li> <li>• For transplants, liquid P fertilisers can be used to promote root growth.</li> </ul>
<p><b>Microbial P will become available over time.</b> When soil temperatures are above 12°C, microbes will mineralise inorganic and organic P, making it available for plants. The higher the microbial activity, the more P cycles in the soil, improving availability.</p>	<ul style="list-style-type: none"> <li>• Maintain soil organic matter levels.</li> </ul> <p><b>MAINTAIN HEALTHY SOIL</b></p>	<ul style="list-style-type: none"> <li>• Use practices that provide food for microbes and maintain organic matter, including: <ul style="list-style-type: none"> <li>• minimise tillage,</li> <li>• growing cover crops rather than having bare soil, and</li> <li>• applying soil amendments, e.g. good quality compost.</li> </ul> </li> </ul>