Phosphorus needs in the north

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Phosphorus is an essential macronutrient required in large amounts for healthy plant growth. It is important in promoting early root formation, growth and the quality of the grain. Phosphorus is also involved in seed formation, photosynthesis and genetic transfer.

In simple terms, each crop extracts the phosphorus from the soil, which is replenished by either the breakdown of organic matter, such as crop stubble or animal manures, or from phosphorus fertilisers.

The uptake efficiency of applied phosphorus is generally low – approximately 20 per cent gets into the crop.

The balance of applied phosphorus can become fixed into some of the less available pools of soil phosphorus.

In the short term, this phosphorus is not readily available for plant uptake, but over a long enough period of time it should become available for plant uptake, depending on the soil's parent material.

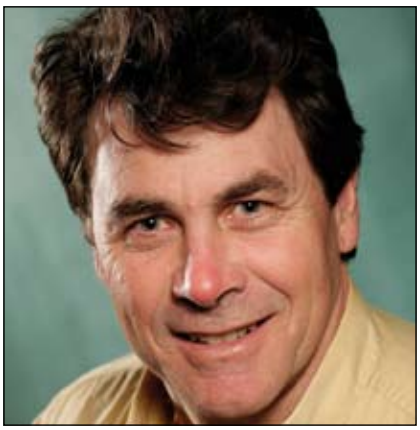
Unlike nitrogen, and to a lesser degree sulfur, phosphorus is immobile within the soil. So the use of soil phosphorus by the plant is greatly dependent on the levels available in the soil and whether these levels can meet the plant's requirements.

The following discussion of phosphorus nutrition principles apply to both summer and winter crops. But we need to bear in mind that due to the cooler soil temperatures in winter when mineralisation, organic matter break down and general soil activity slows, good nutrition management is perhaps even more critical.

Phosphorus uptake

The example in Table 1 demonstrates the different ways that phosphorus is taken up by the maize plant. Sorghum has a similar, if not slightly more efficient root system than maize.

Mass flow, which is the movement of plant nutrients in a flowing soil solution toward the plant root, can only supply so much of the plant's nutrient requirements (about five per cent), with the amount depending on the solubility of the nutrient and the water use by the crop.



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Diffusion is the main form (92.5 per cent) of phosphorus supply to the plant roots, whereby nutrients from zones of high concentration move to zones of low concentration.

As a plant root depletes the phosphorus immediately adjacent to the root, it gets replenished from the soil solution with a higher phosphorus concentration outside the depleted zone.

When soil moisture levels are at or near field capacity, such as after rains or an irrigation event, mass flow operates with little impediment and contributes a relatively larger percentage to nutrient uptake.

As soil moisture conditions decrease, mass flow reduces with the plant's roots relying on diffusion along the concentration gradient to supply phosphorus needs.

In dry seasons this can result in reduced uptake of nutrients like phosphorus and potassium, especially as these nutrients are generally sufficient only in the upper levels of the soil. The plant then has to work much harder to send out a greater root system to find soil moisture, phosphorus and potassium in other areas or at greater depths in the soil.

Sorghum and phosphorus

In comparison to other crops, sorghum tends to have a more efficient root system and reduced leaf area that enables it to withstand or partially resist drought.

A sorghum crop deficient in nitrogen can show more marked or easily recognised symptoms than a sorghum crop experiencing phosphorus deficiency.

Sorghum plants that are mildly deficient in phosphorus may just have a delayed maturity without any outwardly visible symptoms. As deficiency increases, the growth reduction is generally greater in the shoot than in the root, but with increasing severity, the plant's root system may also be reduced. This reduced root system is unable to reach not only soil phosphorus but also soil moisture.

The foliage may become more stunted with the more characteristic dark green to purplish or dark red foliage, leaf sheaths and stems.

Yields last year from Incitec Pivot's long-term fertiliser trial site at Colonsay were between 4.0 to 5.0 tonnes per hectare. The results from the 2007–08 sorghum crop indicates water use efficiency was running at 16 kg grain per mm per hectare.

Results from the same site also show a significant grain yield response from applying phosphorus over nil. On average, this was 320 kg grain per hectare when applying fertiliser phosphorus in a short-fallow back to back sorghum situation.

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TABLE 1: Nutrient demand and uptake mechanisms of maize

Nutrient	Demand (kg/ha)	Root interception	Mass flow	Diffusion
Potassium	195	4 (2%)	35 (18%)	156 (80%)
Nitrogen	190	2 (1%)	50 (79%)	38 (20%)
Phosphorus	40	1 (2.5%)	2 (5%)	37 (92.5%)

SOURCE: Marschner, H., *Mineral Nutrition of Higher Plants.*

2009 STRATEGIES

For farmers to get the best from their phosphorus fertiliser applied to either summer or winter crops, they should:

- Soil test to determine soil phosphorus levels in paddocks;
- Apply the crop's phosphorus requirement at planting or immediately prior to planting;
- Apply the phosphorus fertiliser in a band, either to the side of the seed or with the seed according to seed safety amounts; and,
- Use a water-soluble form of P.