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## The soil phosphorus store

G S P Ritchie

D. M. Weaver

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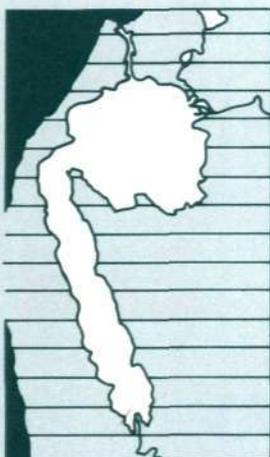
# the SOIL PHOSPHORUS STORE

By **G. S. P. Ritchie,**  
and **D. M. Weaver,**

Department of Soil  
Science and Plant  
Nutrition, University  
of Western Australia

*The management of the soil phosphorus store, or 'super bank' to minimise phosphorus leaching losses is a vital part of any strategy to reduce algal pollution of the Peel-Harvey estuary.*

*Phosphorus can exist in the soil in four main 'pools'. It may occur in the soil solution or in one of three pools that contain phosphorus in solid forms. This phosphorus can be in compounds (fertilisers, dead plant material); adsorbed (attached) to soil particles such as organic matter, clay and iron oxide; or as constituents of micro-organisms.*



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## Importance of different pools

Phosphorus in the soil solution is the only form directly useful for plant growth. However, the other pools can be just as important. They may supply phosphorus to the soil solution and therefore help continue the supply of phosphorus to plants over the growing season.

These pools are not separate entities and phosphorus is continually moved or cycled from one pool to another. Some of the phosphorus in each solid pool cycles very slowly whereas other forms cycle quickly. It is the latter which is readily available to plants.

In nature the levels of phosphorus stored in each pool barely change. However, when phosphorus is added as a fertiliser or dead plant material, most of it tends to change into another solid form.

If phosphorus is lost by leaching or plant uptake, the soil solution pool is depleted. Phosphorus from the solid pools moves in to make up this loss. The extent of this movement and therefore the replenishment of the solution pool depends on the type and size of solid pools that exist in the soil.

## Pools in sandy soils

In sandy soils low in organic matter (similar to those found on the Swan coastal plain), the pools of solid phosphorus are naturally very small and there is little storage.

When these soils are used for pasture production, the application of superphosphate over many years leads to a build-up of phosphorus. This phosphorus is adsorbed by a steadily increasing level of organic matter, assimilated by soil micro-organisms and exists as a fairly insoluble form in the residual fertiliser granule.

## Cycling of phosphorus

The weather pattern on the coastal plain plays an important role in phosphorus losses from the pools in sandy soils.

Winter rainfall leads to phosphorus losses by leaching and run-off. If there is continuous rain after fertiliser application, the loss of phosphorus is governed mainly by the solubility rate of the recently applied fertiliser and the extent of adsorption of the dissolved phosphorus on to soil particles.

If there is a one to two day pause in rainfall after application, the amount of phosphorus lost decreases because of further adsorption during the pause. After longer periods without rain, the phosphorus lost reaches a constant value, probably because a balance is reached between the phosphorus levels in the different pools in the soil.

As the season progresses, the level of phosphorus lost will decrease because the rate of loss by leaching and run-off is greater than the rate of replenishment of the soil solution from the readily available solid pools.

Once this stage is reached, pauses in rainfall can have the opposite effect on phosphorus losses than when they occur just after fertiliser applications. In this case, intervals between rainstorms will increase the phosphorus lost once rain starts again because phosphorus moves from the solid pools into the soil solution when it stops raining.

The movement of phosphorus between pools continues during the following summer. The rate of movement is increased by higher soil temperatures and occasional summer rain that wets the soil, but not sufficiently to cause leaching losses.

If enough phosphorus remains in the slowly available solid pools at the end of winter, the readily available solid pools and the solution pool can be replenished to a level similar to that which existed at the beginning of the previous winter. This process can continue each year as long as enough phosphorus is stored in the soil.

A lot of sandy soils on the coastal plain that have been under pasture for more than 20 years probably contain more than adequate phosphorus for plant growth. Phosphorus fertiliser applications may be unnecessary for several years. These soils could take some years to run-down their phosphorus store, even if phosphorus fertilisers are no longer applied.