

# Measuring, using and budgeting reserve P and K soil reserves - a summary of recent research; phosphorus buffering index and its role; K interactions with Na and implications for K management

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## Key words

phosphorus, potassium, PBI, sodium, soil reserves

## GRDC code

UNE00022

## Take home messages

Monitoring available phosphorous (P) and potassium (K) in the surface (0-10cm) and subsoil (10-30cm) remains important, whilst one-off measurement of reserve P and K can provide guidance on management strategies.

There is no evidence that flooding or increased legume rotations can accelerate release of P or K from reserves into labile soil pools.

There are no district wide indicators of reserve P and K status as cropping history and management result in wide variation across the northern grains region (NGR) (so you need to measure it yourself). In season management should not be adjusted for reserve P and K status.

Advisors should incorporate Phosphorus Buffering Index (PBI) (corrected with Colwell-P) and CEC into their thinking around responsive Colwell-P and exchangeable K levels.

Most NGR soils (except Ferrosols) have PBI values of 150-250, meaning applied P remains available to crops through the season, and unused P should be available the following season. Responsive Colwell P levels in soils (<25 mg Colwell-P/kg for most circumstances) need not be adjusted unless PBI values are above ~250 mg.

Responsive exchangeable K levels should increase with CEC due to increased buffering of K. We welcome feedback from advisors as to whether the (CEC/50) cmol K/kg soil (the theoretical estimate) separates K responsive from K unresponsive soils. We suspect that whilst critical K values increase with CEC, they may not increase linearly above a CEC of 40 cmol/kg.

Crop species are very efficient at acquiring K from soil solution, even in the presence of high solution sodium (Na). However high exchangeable Na concentrations often reduce porosity, increase bulk density and prolong waterlogging which physically impedes root movement through soil, increases diffusion pathways to root surfaces and lowers K uptake rates. Advisors should target increasing the volume of soil explored by a root system through amelioration of physical constraints arising due to high exchangeable Na.

Roots do not proliferate in response to applied K bands. However, there is evidence that K recovery increases when co-applied with P due to both increased root length in the band, but also through increased soil volume exploration. Application strategies for K should seek to treat the largest feasible volume of soil, either by off-setting bands each year, or broadcasting and incorporating during any strategic tillage events.

Because soils in the NGR do not contain appreciable amounts of K 'fixing' clay minerals such as illites or vermiculites, there is little evidence that they 'fix' applied K. Regular K applications that replace the amount of K removed each year in harvested products should be sufficient to maintain adequate levels of soil K.

Plant available soil zinc (Zn) concentrations will fall in response to prolonged crop removal, and Zn availability to crops may also be reduced in reduced till or zero till systems because of increased surface stratification in higher clay soils. Monitor plant tissue Zn concentrations each season to identify paddocks likely to be responsive to Zn.

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