Department of **Water and Environmental Regulation**
Department of **Primary Industries and Regional Development**

GOVERNMENT OF WESTERN AUSTRALIA

uPtake
Trials - Innovation - Partnerships
Delivering better fertiliser outcomes

uPtake trial summary
2019-2023

The award-winning uPtake project has increased farmer and industry confidence in the science behind phosphorus fertiliser recommendations by validating national critical soil test values for phosphorus (P) for south-west WA.

Why are these trials important?

Soil testing over the past 10 years has shown that more than 70 per cent of grazing paddocks in south-west WA contain more phosphorus than is required to achieve target production levels.

Applying P to soils with already high P levels increases the risk of P loss to the environment and increases input costs to farmers.

> "The main aim of the uPtake project was to build farmers' confidence in soil testing and the science behind critical values so they can confidently make fertiliser decisions based on their soil test results".
> ***David Weaver, Principal Research Scientist, Department of Industries and Regional Development***

Key learnings from the trials

The national critical soil test P values are relevant to south west WA soils and contemporary pasture species

Adding P to soils with adequate P will not grow more pasture but will increase the risk of P leaching to the environment

Addressing limiting nutrients like nitrogen, sulphur, potassium & trace elements will increase productivity if nutrients are deficient

Soil testing is critical to identify nutrients that may be limiting production

Applying P following national critical values will optimise productivity, profitability and reduce impacts on the environment

uPtake terminology

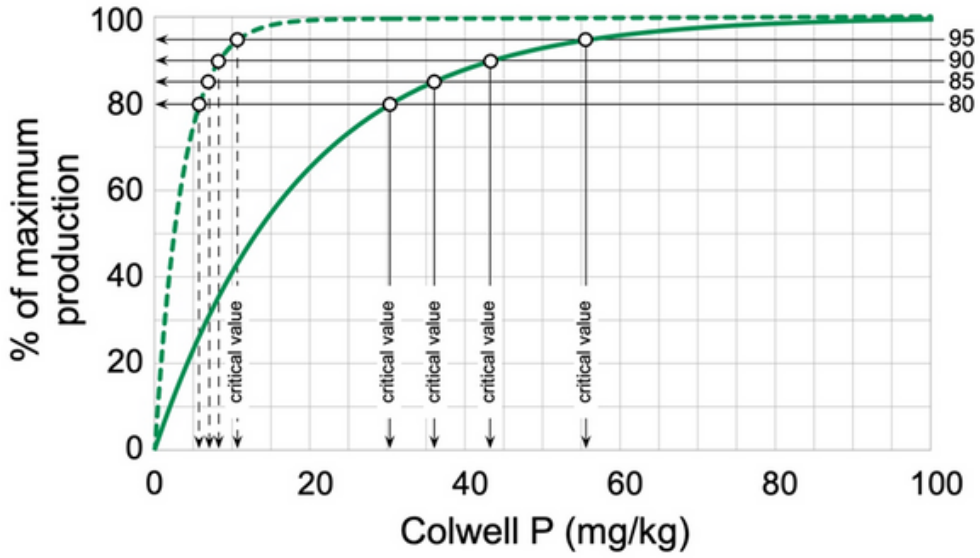
Critical values define the concentration of P needed in the soil, as measured by a Colwell P test, to reach a desired production target.

Colwell P is a measure of phosphorus in the soil that is available to plants.

Production targets are chosen by the farmer to meet production needs and are expressed as a percentage of the maximum production achievable within a growing season on a given paddock when all nutrients are in adequate supply.

National critical values are defined from the national Better Fertiliser Decisions for Pasture program (BFDP) and are based on phosphorus rate-response experiments undertaken over the past 50 years across Australia for high rainfall pastures. The BFDP identified critical values for P for 12 Phosphorus Buffering Index (PBI) classes.

Phosphorus Buffering Index (PBI) is a measure of the soil's ability to retain P. The higher the PBI, the more P the soil can hold. The lower a soil's PBI is, the less ability it has to hold P and therefore the risk of P loss to the environment is greater.



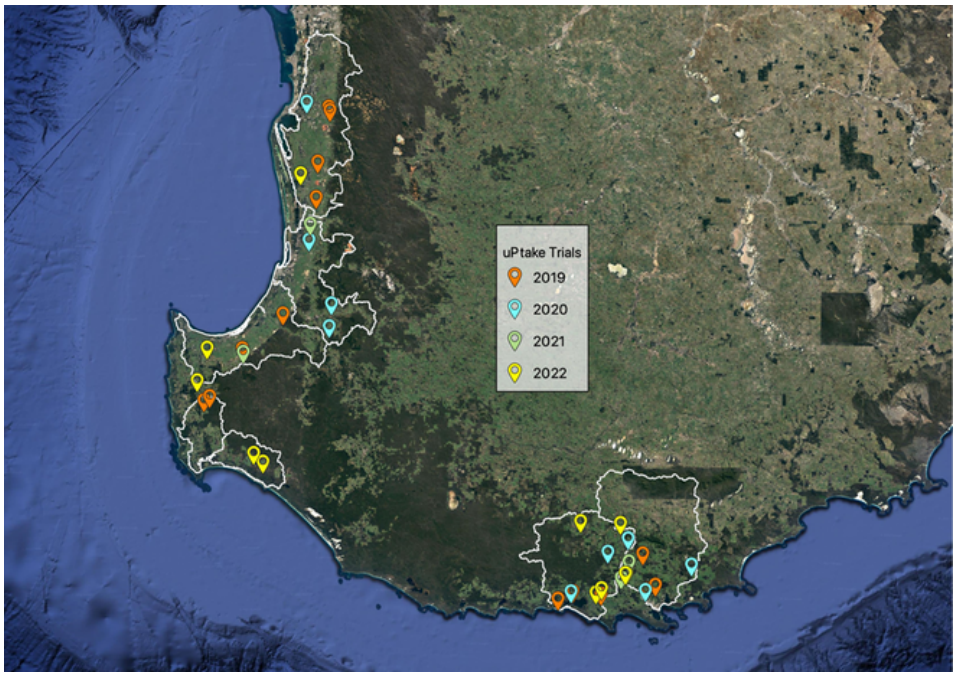
Phosphorus response calibration (examples pictured above) is used to define critical values of P for target production levels. This shows a typical P response calibration for a low (dashed green line) PBI and high (solid green line) PBI soil with example critical values of P shown for production targets of 80 to 95 per cent of maximum production. The higher the PBI, and the higher the production target, the higher the Colwell P level required to reach the critical value.

P Fertility Index (PFI) simplifies the interpretation of soil test results to determine whether soil phosphorus is deficient or in excess. The PFI is calculated from soil test Colwell P and critical Colwell P. A Fertility Index of 1 is optimal. Soils with a Fertility Index less than 1 are deficient and greater than 1 have nutrients in excess.

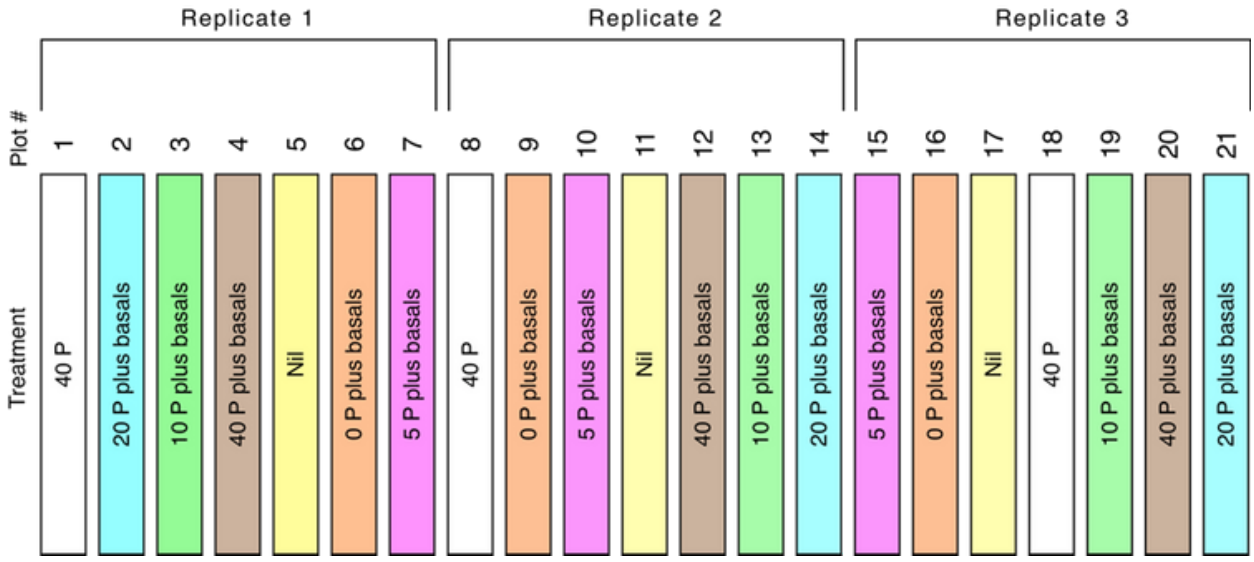
$$\text{P Fertility Index} = \frac{\text{Colwell P in soil test}}{\text{Critical Cowell P}}$$

uPtake trials

We established 52 trials over four years from the Peel-Harvey catchment in the north down to Oyster Harbour in the south. Some trials occurred at the same site for up to four years and allowed P build-up and run-down to be explored. The trials were conducted across a range of soil types with different soil PBI and P Fertility Index to represent soil conditions present across south-west WA.



Pasture growth was measured in response to P application rates ranging from 0 - 40 kg/ha, both with and without basal nutrients. Basal nutrients applied were nitrogen, potassium, sulphur, and some trace elements. Pasture cuts were taken every 4 to 6 weeks depending on the growing season with all pasture removed from the trial plots. Most trials sites were fenced to exclude stock. The trial design is pictured below showing trial replication and treatments. P rates are in kg/ha.



uPtake results

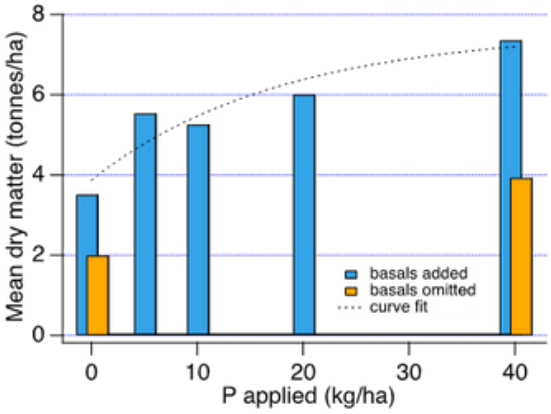
Pasture growth

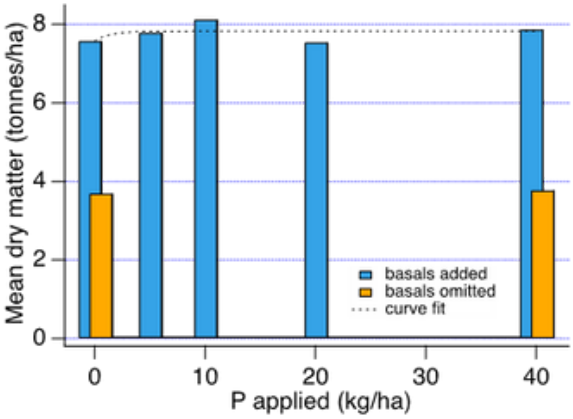
The uPtake trials included sites that we expected to be P responsive (P Fertility Index less than 1) and non-responsive (P Fertility Index greater than1). The figures below show the results of a typical P responsive and non-responsive site.

In the example of a responsive trial (below left) there was an increase in dry matter with the addition of P, although there was no difference in that response between application rates of 5, 10 and 20 kg/Ha (blue bars). With a starting P Fertility Index of 0.44 and a medium PBI of 37.7, the response to P on this trial was consistent with predictions based on national critical values.

In the example of a non-responsive trial (below right) there was no pasture response with the addition of P even at the highest rates of P (blue bars). This result was also expected as the trial had a high PBI of 153 and P Fertility Index of 2.06.

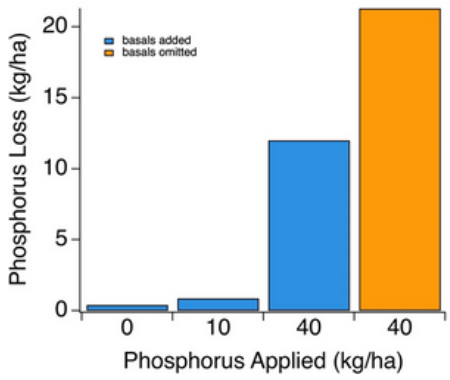
Importantly, at both sites there was a significant increase in dry matter production with the addition of basal nutrients (nitrogen, potassium, sulphur, and some trace elements) as shown by the blue bars. Treatments without basal nutrients applied are shown as orange bars. This result highlights the importance of addressing limiting nutrients other than P on both P responsive and non-responsive sites.





Water quality

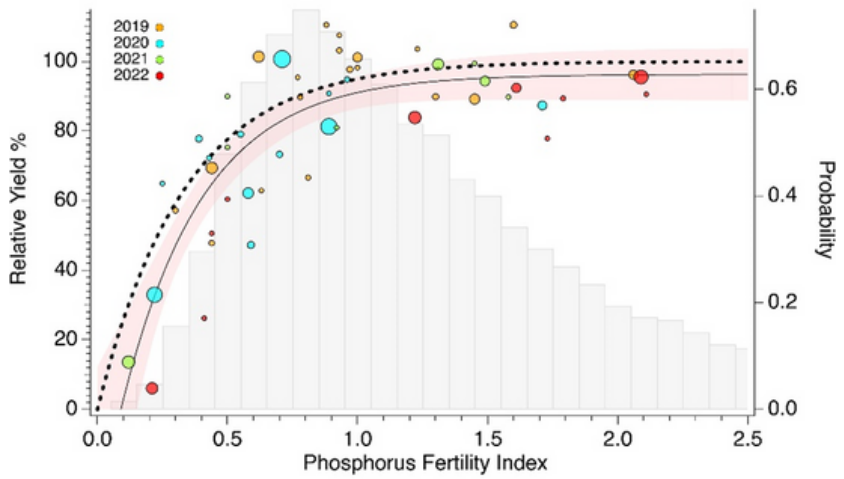
P leaching was determined on three uPtake trials with low PBI using lysimeters to capture leachate. Low-PBI sites were chosen as they have a high P leaching risk. P leaching was measured for different P rates, with and without basal nutrients. The example (right) shows considerably more P loss from plots with 40 kg P/ha applied in comparison with the plots with no P applied and 10 kg P/ha. At this high application rate and without basal nutrients, more than half of the P applied was lost.



A key finding of these trials was that the amount of P leached was reduced by 40 per cent at the 40kg/ha rate when basal nutrients were also applied. This demonstrates that pasture is better able to utilise P when all nutrients are supplied, achieving both higher rates of production and reducing P loss to the environment.

How did we compare to the national data?

Results from the 52 uPtake trials were consistent with national data. The plot below shows the uPtake trial data as points with the size of the point increasing with increasing soil PBI. The trial data compares well with the national BFDP model (black dashed line) demonstrating the national critical Colwell P values are relevant to south-west WA conditions and to contemporary pasture species that were used in the uPtake trials.



uPtake project partners

We worked with 36 farmers who hosted trials and field days on their farms with support from six catchment groups. More than 1,000 farmers and industry representatives attended field days, events, and webinars on the uPtake project.



A Technical Reference Group (TRG) was established at the beginning of the project with representatives from the fertiliser and grazing industries, government scientists, private agronomists, catchment groups, farmers, and universities. The TRG, pictured below, designed the trials, selected sites, and reviewed trial data.

Thank you to our partners and host farmers

PHCC Working Together Peel-Harvey Catchment Council
GeoCatch
Leschenault Catchment Council
Lower Blackwood Catchment
Oyster Harbour Catchment Group
WICC
The University of Western Australia
Murdoch University
SWCC south west catchments council
Fertilizer Australia
CSBP
Summit Fertilizers
Nutrien Ag Solutions
Western Beef Association Inc
mla Meat & Livestock Australia
Dairy
Dairy Australia
Soil Wise

Australian Government | National Landcare Program

HEALTHY ESTUARIES WA

uPtake is jointly funded through the State Government's Healthy Estuaries WA and the Australian Government's National Landcare Program.