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# WHOLE FARM SOIL TESTING:
# SOIL FERTILITY TRENDS OVER TIME

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## Abstract
Traditionally nutrient management was based upon soil test results obtained from monitor paddocks representative of different topographies, management and soil types. Greater environmental consciousness and economics contributed to the process of Whole Farm Soil Testing being established to improve nutrient monitoring and fertiliser application. Ravensdown has been offering this service since 2011, with the aim to reduce variability between paddocks and driving nutrient levels closer to optimum range limits. A random selection of test results for pH, Olsen P and MAF QT K from 160 properties spanning the period 2011 to 2017 were paired with year of first sampling resulting in more than 18,000 sample pairs (Year1:Year 2, ………, Year1: Year7). These sample pairs were separated into three scenarios based on whether the first year results were below, within or above the optimum level for the particular soil parameter. Mean values for consecutive years following first year of sampling showed that initial below optimum value paddocks trended higher, within optimum range paddocks remained within the optimum range and above optimum range paddocks trended lower. Encouraging from an environmental and economic perspective was the decreasing trend where initial values were above upper optimum range limits. It can be concluded that the practice of Whole Farm Soil Testing is a responsible approach to nutrient management with changes in mean parameter values ideally ascribed to improved nutrient management.

## Introduction
Initial soil sampling practices established in New Zealand comprised having a number of monitor paddocks representative of soil type and land use, on which soil test results, fertiliser applications for the whole farm is based. Differences in soil test nutrient levels developed over time that can essentially be ascribed to differences in nutrient input and export between paddocks e.g. crop removal, fertiliser application, leaching of nutrients and stock management. Reducing soil variability within soils at paddock level can not only improve overall yield, but is an environmentally more sustainable and cost effective approach to managing soil fertility.

Since 2011 Ravensdown have been promoting the practice of Whole Farm Soil Testing (WFST) to enable customers to better manage nutrient differences between paddocks. WFST comprises intensive sampling of paddocks followed by repeat sampling to monitor the efficacy of fertiliser programs aimed at managing nutrient levels within the optimum levels for crop and pasture production.

Previously there were reported on progress of WFST (Withnall & Bowie, 2015; Bowie & Venter, 2017). It is expected that as time progress the effect of this approach will become more pronounced. The aim is to provide further proof that WFST is a responsible approach to soil nutrient management both from an economic and environmental perspective.

## Data

A random selection of test results for pH, Olsen P and MAF QT K from 160 properties spanning the period 2011 to 2017 were paired with year of first sampling resulting in more than 18,000 sample pairs (Year1:Year 2, ………, Year1: Year7). These sample pairs were separated into three scenarios based on whether the first year results were below, within or above the biological optimum level for the particular soil test parameter. For each soil parameter a single optimal range irrespective of soil type was chosen and applied to all data. A subset of data representing only consecutive sampling for each of years 1, 3, 5 and 7 comprising data for 500 paddocks for MAF QT K and 600 paddocks for Olsen P and pH were extracted to compare trends with the larger data sets.

## Results

Mean values for consecutive years following the first year of sampling, showed that initial below optimum value paddocks trended higher for all three parameters (Figures 1, 2 & 3).

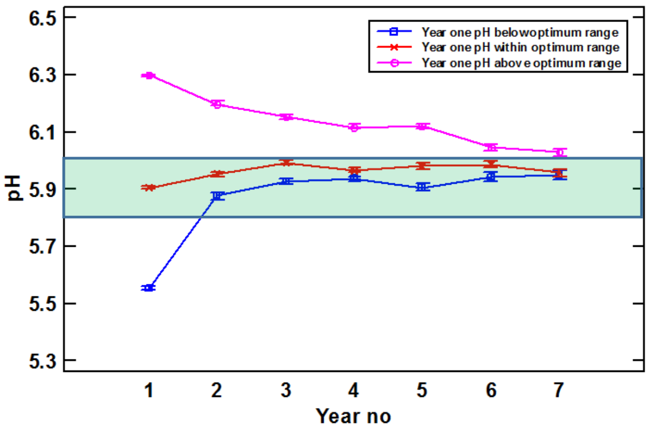


**Figure 1.** Annual change in mean pH value for paddocks starting in year one with pH values either below, within or above the 5.8 – 6.0 optimum range (demarcated in the shaded area).

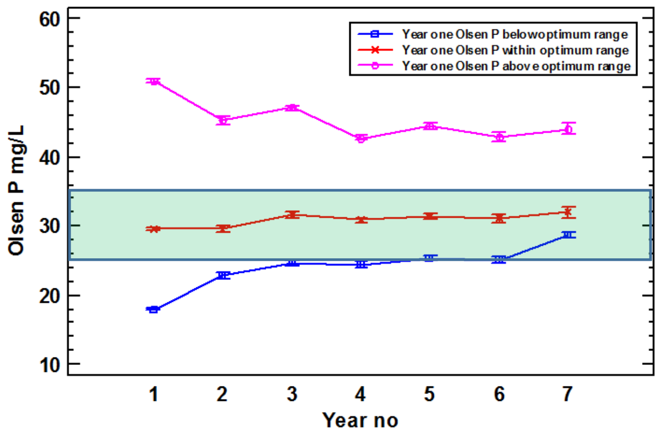


**Figure 2.** Annual change in mean Olsen P values for paddocks starting in year one with Olsen P values either below, within or above the 25 – 35 mg/L optimum range (demarcated in the shaded area).

Within optimum range paddocks remained within the optimum range for pH, Olsen P and MAF QT Potassium. Initial below optimum pH range paddocks increased to within the pH optimum range of 5.8 to 6.0 by year two. Encouragingly, from both an environmental and economic perspective, a decreasing trend was observed for all three parameters where initial values were above the upper optimum range.

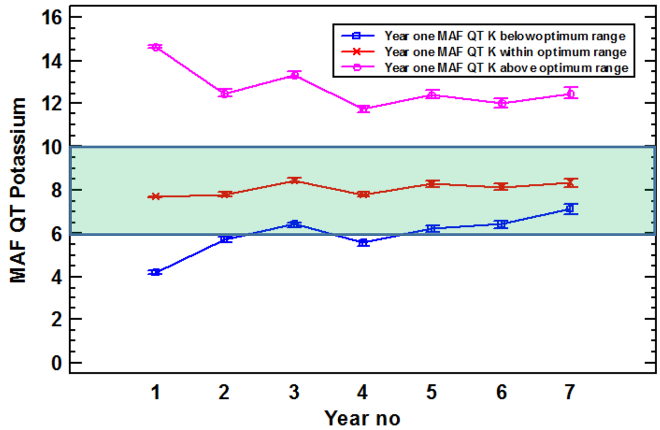


**Figure 3.** Annual change in mean MAF QT Potassium values for paddocks starting in year one with MAF QT K values either below, within or above the 6 – 10 mg/kg optimal range (demarcated in the shaded area).

***Years 1, 3, 5, and 7***

Trending observed for regular sampled paddocks (Figures 4, 5 & 6) support the trends observed for the larger but inherently less complete data sets. This agreement cross validates the methodology used to present the data from the larger datasets where sampling frequencies were irregular and repeat sampling varied between one and six events.

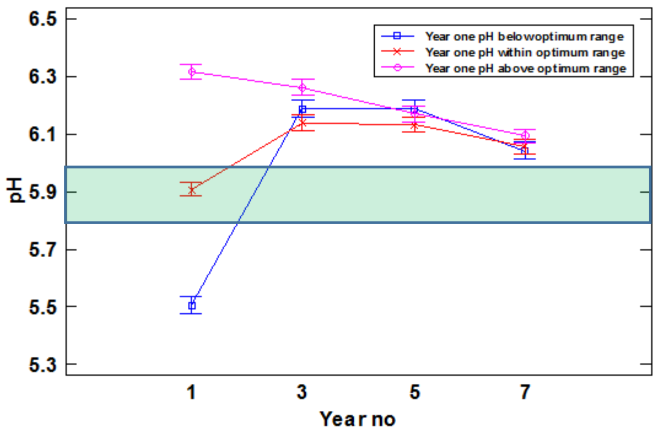


**Figure 4.** Annual change in mean pH value for paddocks starting in year one with pH values either below, within or above the 5.8 – 6.0 optimum range (demarcated in the shaded area).

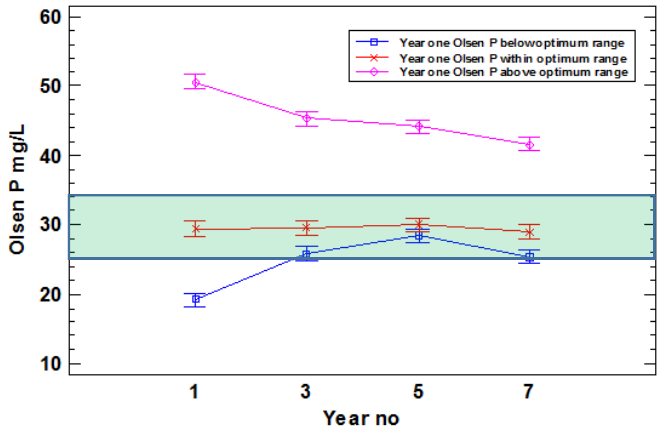


**Figure 5.** Annual change in mean Olsen P values for paddocks starting in year one with Olsen P values either below, within or above the 25 – 35 mg/L optimum range (demarcated in the shaded area).

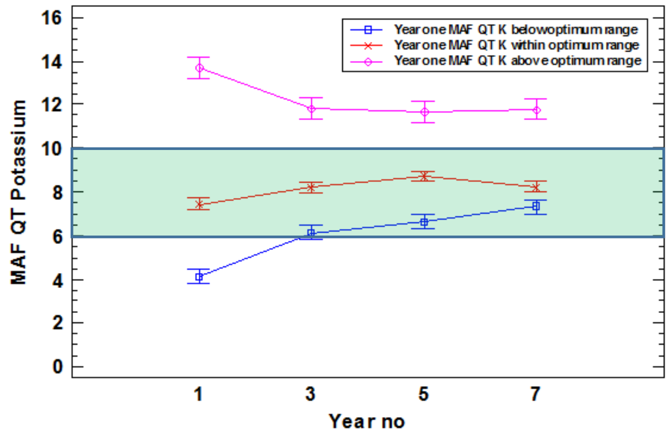


**Figure 6.** Annual change in mean MAF QT Potassium values for paddocks starting in year one with MAF QT K values either below, within or above the 6 – 10 mg/kg optimal range (demarcated in the shaded area).

## Conclusion

It can be concluded that the practice of Whole Farm Soil Testing is a responsible approach to nutrient management with observed changes in mean soil test values ideally ascribed to improved nutrient application decisions. Mean nutrient values converging to the optimal ranges illustrate the effect that more intensive nutrient management have on nutrient levels in the soil. Reducing excessive nutrient levels and increasing sub optimal levels over time have positive economic and environmental consequences. These trends also illustrate the effect of appropriate advice provided to customers by the Ravensdown team of Agri-Managers.

## References

Withnall, R. & Bowie, S., 2015. Whole farm testing: a review of data. In: Moving farm systems to improved attenuation. (Eds L.D. Currie and L.L Burkitt). http://flrc.massey.ac.nz/publications.html. Occasional Report No. 28. Fertilizer and Lime Research Centre, Massey University, Palmerston North, New Zealand. 2 pages.

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