A Comparison of two Commonly used Advisory Soil Extraction Methods on a Range of Agricultural Soil Samples: Implications for Fertiliser P Recommendations and Systems P use Efficiency

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Introduction

- The use of soil nutrient testing is a tried and tested approach to guide growers on their application rates for key crop fertiliser inputs.
  - In the UK, the two main extraction methods used for estimating soil available P are Olsen which is used predominantly in England and Wales (Defra, 2010), and Modified Morgan extraction typically used north of the border in Scotland (Sinclair *et al.,* 2010).
- In recent years, the proliferation of commercial analytical laboratories may have led more farmers and agronomists to send soil samples to different laboratories to those traditionally used. There is a risk that the chosen method is less appropriate for the soils being tested and could lead to reduced confidence in P recommendations made.
- Attempts to make broad comparisons between the two extraction methods described and the P index / crop P availability likely from the soil tested do exist (see Table 1).

Table 1: *Comparison of the P index system and theoretical equivalents between Olsen and Modified Morgan Extractable P (reproduced from Sinclair et al., 2010)*

Olsen		Modified Morgan	
Index	Concentration range (mg P L^{-1})	Status	Concentration range (mg P L^{-1})
0	0 – 9	Very low	<1.8
1	10 -15	Low	1.8 – 4.4
2	16 – 25	Moderate	4.5 – 13
3	26 – 45	High	14 – 30
4	46 – 70	Very high	>30
5	71 – 100		
6	101 – 140		
7	141 – 200		
8	201 – 280		
9	>280		

Comparison of Olsen vs Modified Morgan

- The SRUC commercial laboratory had 234 soil samples that had been analysed using both the Olsen and the Modified Morgan methods from 1996 onwards.
- The data in Figure 1 shows how the P concentrations of the soil samples compare between the two methods as well as the P index systems used for each method for 221 samples (13 extreme outliers were removed).
  - There is a better agreement between index classes at lower P concentrations

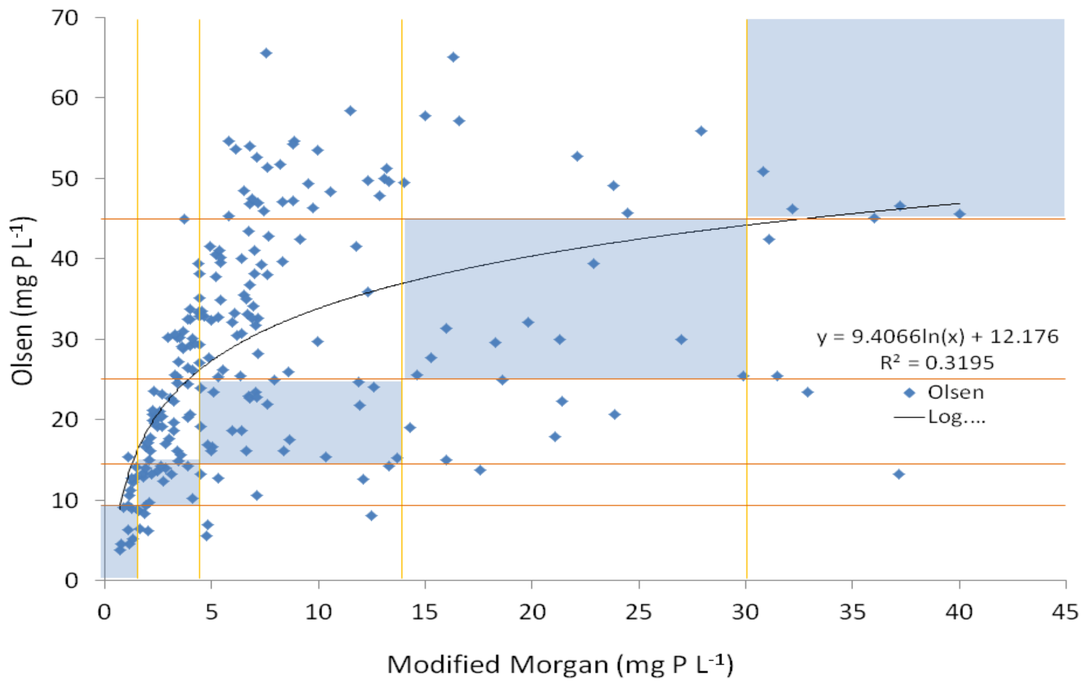

Figure 1: *Extractable soil P concentrations using both Olsen and Modified Morgan methods and how they compare with the P index systems for each method. The shaded boxes should represent equivalent available P between the two methods. A logarithmic curve has been fitted to the data.*

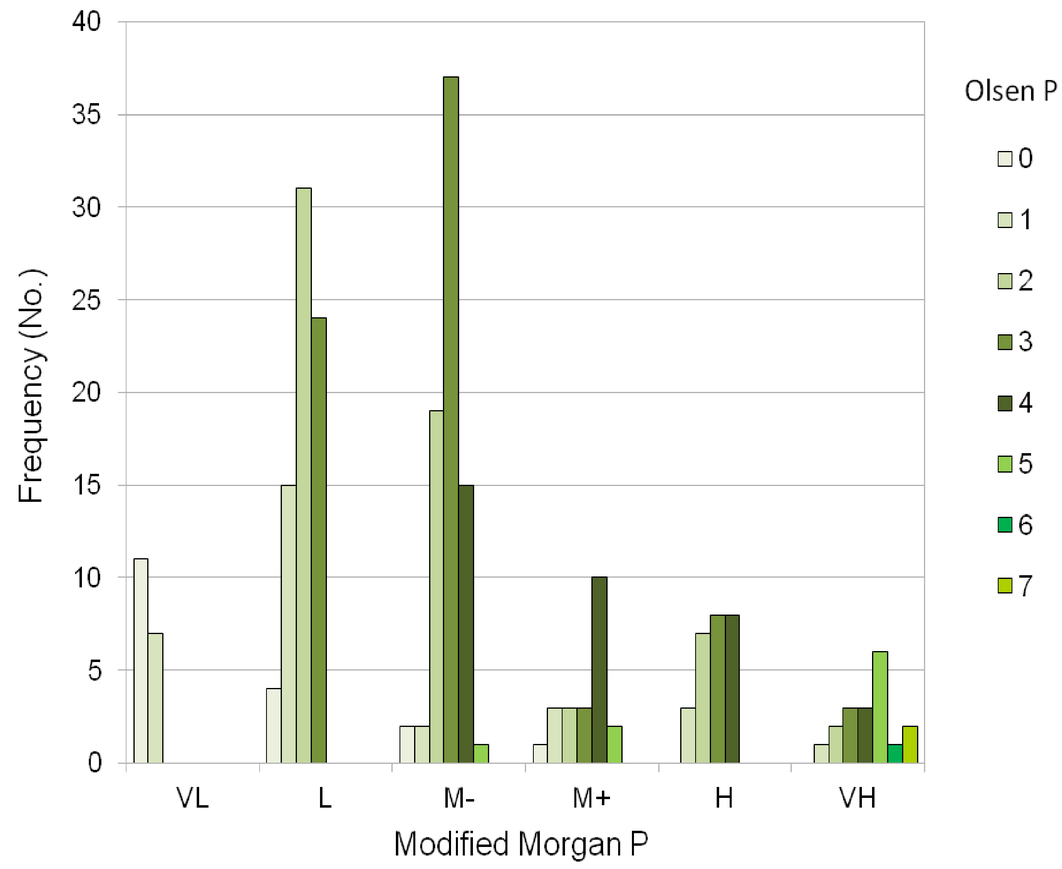

Figure 2: *Frequency of soil samples matching Modified Morgan extractable P categories in relation to their theoretically equivalent Olsen P extractable P index.*

- The range and frequency at which individual soil samples matched their soil P status for Modified Morgan extractable P categories with respect to their corresponding Olsen extractable P index are shown in Figure 2.
  - There is clearly a wide discrepancy between the two soil P extraction procedures discussed and their subsequent analysis
  - The scale and direction of difference was not consistent
    - At L and M- on the Modified Morgan P index categories, there were a very large number of samples in index 2, 3 and 4 using Olsen as a comparison
    - At higher Modified Morgan P index categories, there were still a large proportion of samples in index 1, 2 or 3 using Olsen as a comparison

Conclusions

- The results highlight the potential to either significantly over OR under fertilise crops with P
  - The method used and the physical and chemical properties of the soil are likely to play a large part in determining the extent to which this occurs
- As most P fertiliser recommendation systems are based predominantly on soil P analysis, it is important that the most appropriate soil extraction and analytical method is used to provide the best estimate of P requirement
  - Failure to do so increases the risk of inefficient P fertiliser practices which can manifest itself in two broad outcomes
    - Environmental issues (e.g. nutrient loss to the environment)
    - Additional cost to the farmer (due to excessive P purchases, or yield loss due to P deficiency)

References

Defra (2010) Fertiliser Manual (RB209) Version 8.

Sinclair A, Shipway, P & Wale, S (2010) SAC Technical Note TN633: Phosphorus, potassium, sulphur and magnesium recommendations for cereals, oilseed rape and potatoes.

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