

Evaluating the standard agronomic phosphorus test as an environmental indicator

K. Daly and A. Casey,
Teagasc, Johnstown Castle Laboratories, Wexford.

Introduction

Soil phosphorus (P) status usually indicated by the standard agronomic P test has been linked with field losses of P in Ireland (Kurz et al, 2005) and elsewhere (Pote et al., 1996). Recent debate on the use of Morgan's P test in Ireland as an environmental indicator has criticised the standard sample depth and extracting solution (Mulqueen et al., 2004; EPA, *pers comm.*). This paper evaluates the standard agronomic P test (Morgan's P) as an environmental indicator by questioning aspects of the test such as sample depth and extracting solution against a background of P loss in overland flow.

Materials and Methods

Morgan's P was compared to other environmental P tests such as the iron-oxide strip test (FeO-P), water soluble P (WSP) and calcium chloride extractable P (CaCl₂-P), over a range of mineral soil types. Seventy-six soil samples were collected to 10 cm depth from nine soil associations (Gardiner and Radford, 1980) over a range of P concentrations and extracted using Morgan's P, FeO-P, WSP and CaCl₂-P.

The effect of sample depth was examined by comparing the standard agronomic depth (10 cm) with depths of 2 and 5 cm. Seven grassland sites of varying soil P concentration at Johnstown Castle Estate, Wexford, were used and soil samples taken in triplicate to depths of 2, 5 and 10 cm were extracted using Morgan's P, FeO-P, WSP and CaCl₂-P. Edge-of-field losses of DRP from two of the sites, at low (2.8 mg/l) and high (18 mg/l) soil P, were measured using automatic samplers with integral data loggers (SIGMA 900). Overland flow samples returned to the laboratory were filtered (0.45 µm) and DRP measured colorimetrically. Laboratory extracts of soil P were compared with field losses of DRP and soil samples were taken to depths of 5 and 10 cm from these sites and extracted with distilled water. Phosphorus loss (kg P/ha) from the sites was compared with agronomic and environmental soil P tests used in this study.

Results and Discussion

Morgan's P correlated with FeO-P ($R^2 = 0.71$, $P < 0.001$), WSP ($R^2 = 0.65$, $P < 0.001$) and CaCl₂-P ($R^2 = 0.55$, $P < 0.001$) across a range of mineral soil associations (Figure 1). Extractable soil P increased with decreasing sample depth ($p < 0.001$) as did variances, such that, 2 cm samples had the highest concentrations and variances. Soil P concentrations from the current standard sample depth (10 cm) was linearly correlated with corresponding data from samples taken to 2 and 5 cm (Figure 2), indicating that surface soil P can be consistently estimated from the current sample depth. Average DRP from the high P site and maximum DRP values from the low P site were simulated using laboratory extractions of soil samples. The relative difference in P loss from the high (0.457 kgP/ha) and

low (0.065 kgP/ha) P sites was reflected in the difference in Morgan's P values between the sites.

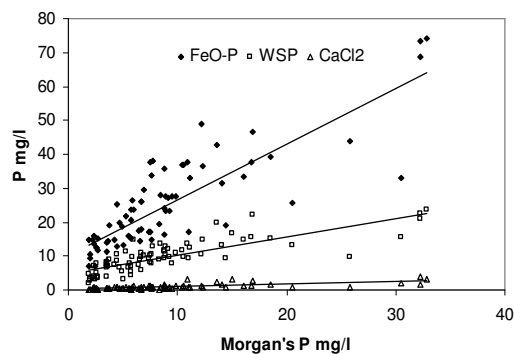


Figure 1. The relationship between Morgan's P and environmental P tests, FeO-P, WSP and CaCl₂-P, in mineral grassland soils.

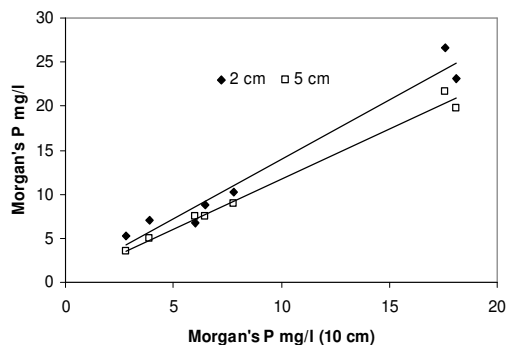


Figure 2. The relationship between Morgan's P at 10 cm and Morgan's P at 2 and 5 cm.

Conclusions

Morgan's P compared well with other environmental P tests, simulating P desorption to solution. There is little justification for changing to a shallow sample depth (with greater variance) when the same information can be obtained from the standard depth (10 cm). The standard agronomic P test, Morgan's P, at the standard 10 cm can provide a good indication of potential losses and agronomic status.

References

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