Soil phosphorus and sulphur in pastures of North-West Slopes and Upper Hunter districts of New South Wales

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Abstract. *Available phosphorus (P) and sulphur (S) was measured in 417 surface soil samples collected during farmer soil health workshops in North-West Slopes and Upper Hunter regions of New South Wales. Phosphorus was deficient in 59 per cent of samples and S was deficient in 81 per cent of samples. Only 12 per cent of all soils tested contained sufficient P and S to support 95 per cent of maximum pasture production. Poor soil fertility is likely to be a major limitation to pasture productivity in these regions.*

Introduction

Soil nutrient testing is being promoted for grazing enterprises in northern New South Wales (NSW) as part of the 'Managing Landscapes – matching soils, climate and enterprises' project within the national 'Healthy Soils for Sustainable Farms' program. Phosphorus (P) and sulphur (S) have been known to be deficient in soils of these districts for over 40 years (Freebairn *et al.* 1994; Edwards and Duncan 2002).

Poor soil fertility often limits nitrogen fixation by introduced legumes and year-round grass production. Nutrient depletion occurs through export of farm produce, but producers are reluctant to replenish P and S due to increasing fertiliser costs. Soil testing in the LANDSCAN™ workshops is providing valuable data on the current status of P and S in grazing soils of the North-West Slopes and Upper Hunter regions.

Methods

Soils were sampled at 0–10 cm depth from native and improved pastures on 97 properties during 2006–2008. Soils were derived from basalt, granite and sedimentary origins. Each analysed sample was a combination of at least six 20 mm diameter cores taken from an area of approximately 100 m^2. Sample locations were recorded with a hand-held GPS for future repeat sampling. Samples were analysed by a commercial laboratory accredited by National Associations of Testing Authorities for available P (Colwell P), phosphorus buffer index (PBI; Burkitt *et al.* 2002) and available S (KCl-40).

Results and discussion

The soil test data were interpreted using recently developed national guidelines for pasture production (Gourley *et al.* 2007). The stated critical values of nutrients are for 95 per cent of potential pasture production.

Phosphorus

Phosphorus deficiency was determined by comparing each Colwell P result with the critical Colwell P for that sample, calculated from its PBI result. Sample Colwell P values were plotted against the corresponding PBI (Figure 1). The critical Colwell P is indicated using (a) standard PBI categories (extremely low, very, very low, etc), and (b) the equation of best fit (Gourley *et al.* 2007). Circles under the dashed line or in shaded areas indicate P deficient soils.

Of the 417 samples, 59 per cent were considered to be deficient. In comparison, 58 per cent of samples fell below the equation line, demonstrating the reliability of the more useful simpler category system. Of the 243 P-deficient samples, 22 soils were within 5 mg/kg of the critical Colwell P concentration, but 182 soils were more than 10 mg/kg below the critical concentration.

Sulphur

Sulphur deficiency was determined by comparing the soil test result against a critical concentration of 8 mg/kg (Gourley *et al.* 2007). Of the 417 samples, 81 per cent were deficient, as indicated in Figure 1 by the white symbols. This 81 per cent included 63 per cent of the total with less than 5 mg/kg S – the critical concentration used by Edwards and Duncan (2002).

Combined P and S deficiencies

Twelve per cent (50) of all soil samples were not deficient in either P or S. Fifty-one per cent (213) of samples were deficient in both P and S, 30 per cent (124) were deficient in S only, and 7 per cent (30) were deficient in P only.

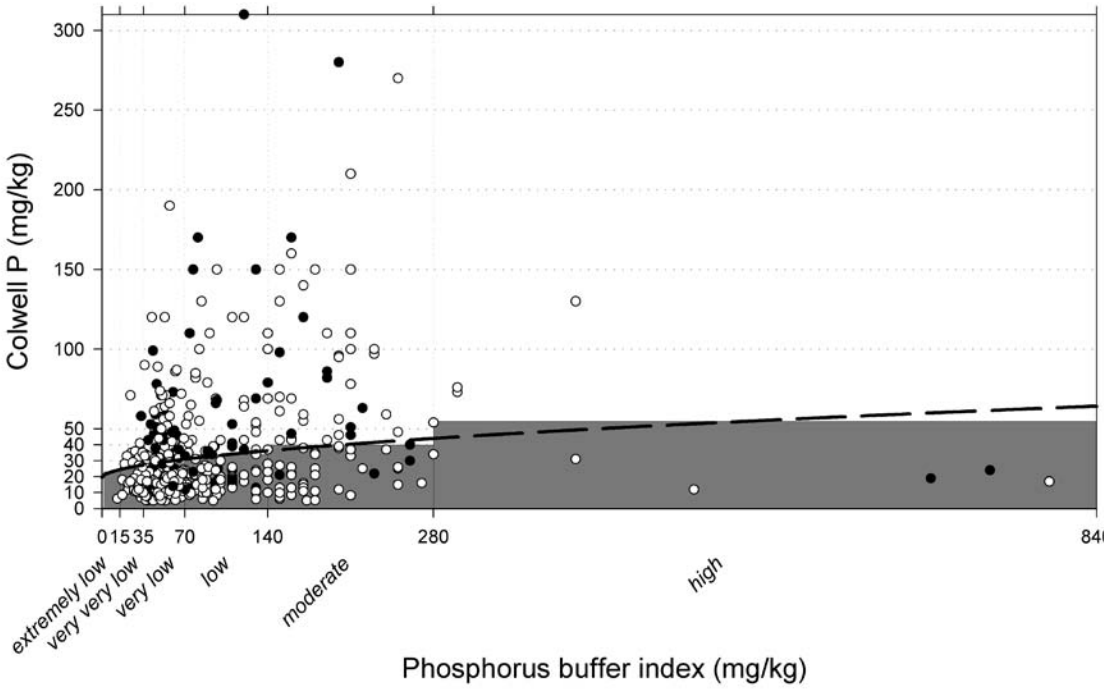

Figure 1. Soil phosphorus and sulphur status in 417 surface soils (0–10 cm) of north-west NSW pastures. Standard PBI categories are shown as shaded rectangles; continuous PBI relationship is shown as dashed line. Open circles indicate samples were also deficient in sulphur (KCl-40, below 8 mg/kg), black circles indicate sufficient sulphur.

Conclusions

On the basis of soil P and S concentrations, only 12 per cent of the soils tested would be able to support 95 per cent of potential pasture production. Most of the deficient soils were highly deficient, not marginally so. This is a serious economic opportunity-cost to the grazing industries of the region. Nutrient-limited pastures are less able also to maintain adequate groundcover for rainfall infiltration and erosion prevention, and are less likely to build up soil organic matter. Producers need greater skills in nutrient management and the LANDSCAN workshops have focussed strongly on building confidence through better understanding of soil tests and nutrient cycling in the grazing system. Further work is still needed to quantify and publicise the cost-benefit ratios of better nutrient management in these northern NSW pastures.

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