Trends in phosphorus status can be assessed by testing pasture soils in late spring

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Abstract

Temporal variation in soil phosphorus (P) was examined in pastures that had been fertilised with P rates of between 1 and 33 kg P/ha.year over 20 years at Hamilton, Victoria. Samples of topsoil were taken along a series of fixed transects every month for 3 years. Soil tests are best used to assess trends in soil fertility with time. In this case frequent sampling enabled a trend of increasing soil test to be assessed with reasonable confidence. When the average P applied annually was 15 kg/ha, the slope of the linear trend for $\log_e$(Olsen P), that is: $\log_e$[mgP/kg soil]/year, was 0.136? 0.02. If once-a-year sampling is used to assess trends, soils are best sampled when deviations from the trend line are consistent or small. At Hamilton (a clay loam derived from basalt), a suitable time to do this is late spring.

Key Words

Pasture, soil, available phosphorus, temporal variation

Introduction

Soil tests are a useful means of assessing the phosphorus (P) status of grazing systems.

Tests for ‘plant-available’ P reflect the P status of grazing systems (1), hence assessing changes in ‘plant’available’ P from one year to the next can be used to assess if applications of fertiliser are sufficient to maintain the P status of grazing systems. Generally, recommendations stress that samples should be taken at the same time of year in order to avoid possible seasonal variation in tests (2). This issue was examined by taking samples of topsoil (0-10 cm) every month for 3 years in each of the 18 plots of a long-term experiment at Hamilton, Victoria (2).

Methods

The impact of P fertiliser on animal production has been assessed on the long-term phosphate experiment at Hamilton since 1979, where 6 levels of P fertiliser have been compared at 3 grazing pressures. Mean annual applications of P range from 1 to 33 kg/ha. From January 1998, a pair of soil cores (0-10 cm) was taken every 5 m along a 50 m transect in each plot every month for 3 years. The soil from each sampling was bulked, dried at 40?C, and samples analysed for Olsen P (3) and Colwell P (4). Date were fitted to a linear mixed model with a cubic spline for time to test for effects of P status and time of sampling on trends in extractable P. The 3 grazing pressures were treated as replicates. Data were transformed to logarithms because preliminary statistical analyses revealed that variation in residuals was greater where the P status was high.

Results and Discussion

The linear trends and fitted departures from them for 2 contrasting amounts of P are shown in Figure 1. Values of both Olsen P and Colwell P were expressed as mg P/kg soil before transformation to natural logarithms. The amounts of P applied represent mean amounts applied annually since the pastures were sown in 1979. Fitted departures from the linear trends were not related to amounts of P applied, however positive departures from linear in the first third of each year were probably due to applications of fertiliser in the autumn. Linear trends at the lowest rate (Figure 1a) did not differ from zero. However, soil test

values when 15 kg P/ha.year was applied were still rising. This was despite a 19-year equilibrium period (1979-1987) prior to the commencement of this study.

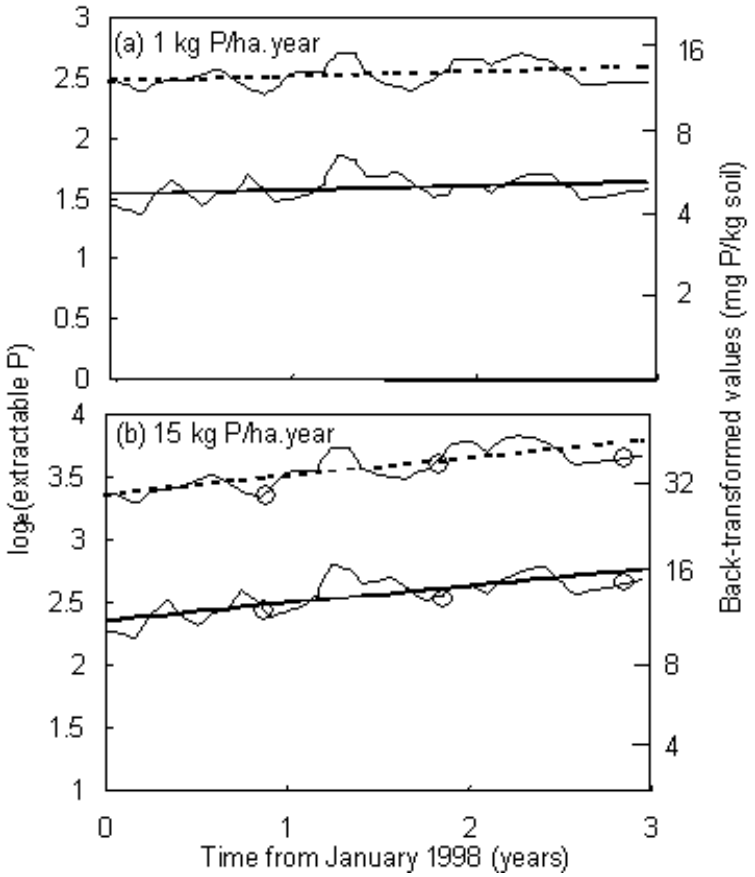

Figure 1. Fitted linear trends (thick lines) in the natural logarithm of Olsen P (continuous line) and Colwell P (dashed line) for 2 levels of P fertiliser over time. Amounts of P applied are average amounts applied annually since 1977. The thin lines are fitted splines showing departures from linear.

Trends in soil P over time could be detected with acceptable precision with monthly sampling, but sampling every month is expensive. The slopes for $\log_e$Colwell P and $\log_e$Olsen P in Figure 1(b) were 0.136?0.0201, and 0.143?0.0204 respectively. The sampling time most consistent with the overall trend was in late November pastures were drying. Sampling at this time (small circles in Figure 1b) gave a reasonable estimate of the trend in time (slope), and in the absence of other work, is recommended as a suitable time for sampling pasture soils in SW Victoria.

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