Phosphorus Gradient due to Landscape in Variable Native Pastures

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Introduction

In the high rainfall zone of southeastern Australia the addition of superphosphate fertiliser and subterranean clover (*Trifolium subterranean*) have been widely used to increase the production of native grasslands. In recent years pasture productivity and the use of superphosphate fertiliser has declined (Kemp and Dowling 2000). This paper examines the relationship between soil phosphorus (P) and pH ($CaCl_2$), landscape and species composition for a 'typical' native pasture paddock on the central tablelands of southeastern Australia.

Material & Methods

The site was 40 ha in size, had an average annual rainfall of 809 mm, and was highly variable in altitude (820 - 870 m), aspect, slope, and soil depth and texture. The soils were brown chromosols and kurosols (Isbell 1996), derived from siltstone. The native pasture was dominated by *Microlaena stipoides* and *Austrodanthonia* spp. and had a moderate superphosphate fertiliser history (i.e. ~125 kg/ha every three years).

Soil samples and pasture composition were monitored on a 33 x 33 m grid across the site in September 2007. At each point 10 soil cores (25 mm wide x 100 mm deep) were taken within a 4 m^2 area and were analysed for P (Bray) and pH ($CaCl_2$) (Rayment and Higginson 1992). Pasture composition and herbage mass were assessed using BOTANAL techniques (Tothill *et al.* 1992).

Grazing was excluded for the first 6 weeks of spring in 2007, a period of below average rainfall, and the site was mapped into three production zones by visually estimating green herbage mass and marking boundaries with a hand held GPS. The production zones were: 1) high production zone (HPZ) – pastures were actively growing, 2) medium production zone (MPZ) – pastures were beginning to dry and annual species had set seed; and low production zone (LPZ) – pastures had dried off with no living annual species. REML(Payne *et al.* 2009) was used to determine differences in factors between production zones.

Results and Discussion

There were significant ($P<0.001$) gradients from the HPZ to the LPZ for soil P, pH, herbage mass and subterranean clover (Table 1). The inverse relationship between P and clover was unexpected, as P often limits clover production in southeastern Australian. The LPZ had shallower and more coarsely textured soils with a lower water holding capacity that most likely limited pasture production and clover persistence resulting in incomplete utilisation of applied P. Movement by sheep and immobilisation due to seasonal water logging are two other possible causes of the P gradient, although sheep camps were excluded in this analysis. These finding suggest superphosphate application should target the most productive part of the landscape.

Production Zone	Area	P	pH	DM	Sub clover
High (HPZ)	8.0	6.5a	4.7b	1429c	200c
Medium (MPZ)	23.2	18.9b	4.5a	1151b	71b
Low (LPZ)	8.3	40.7c	4.5a	905a	23a

Table 1. The area (ha), average soil P (mg/kg) and pH, pasture DM (kg/ha) and subterranean clover (kg/ha) for the different production zones. Values followed by different letters are significantly different ($P<0.001$)

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