LONG TERM EFFECTS OF LIMING A BASALT-DERIVED SOIL, ON LUCERNE AND PHALARIS PRODUCTION

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ABSTRACT

Lime incorporated into a basalt-derived clay loam lowered exchangeable aluminium in soil. Soil pH was still elevated, 9 years after 2 t/ha of lime was incorporated. With lower rates of lime the density of lucerne plants declined. Lucerne yield more than doubled with lime. After six years, the area was sown to a phalaris-clover pasture. A 15% increase in the yield of phalaris was recorded from limed plots over the next three years. Despite this, 11 years after liming, herbage P concentrations increased with lime, from 0.28% to 0.35%.

KEYWORDS

Subterranean clover, phosphorus, sulphur, earthworms, trace elements

INTRODUCTION

Long-term responses in pasture growth have been noted following lime use on kraznozem (Rowe and Johnson, 1988). On the basalt soils in south western Victoria, wool production declines when application of phosphate fertiliser ceases (Kelly and Reed, 1980). Fertiliser lifts the profitably of sheep enterprises (Saul *et al.*, 1993). The value of wool relative to lime is low and graziers see fertiliser giving a better return. Lucerne grows well on the crest of the basalt catena but not lower down where drainage is too impeded (Reed and Flinn 1993).

MATERIALS AND METHODS

An area of old pasture was fallowed at Hamilton in May 1981 and lime incorporated to a depth of 5 cm in June 1982. A latin square experiment with six rates of lime (0, 0.5, 1, 2, 5 and 10 t/ha) and six replicates was laid out down the slope from the crest to the flat of the catena. Plots measured 30 m x 4 m. The basalt-derived, acidic, hard-setting, duplex clay loam had pH of 5.3 and was low in available phosphorus, potassium and exchangeable magnesium (Table 1). Lime, from pits at Portland, contained 32% Ca and 0.5% Mg. The area was drill-sown to a mix of lucerne (*Medicago sativa*) and subterranean (sub) clover (*Trifolium subterraneum*) on 20 August 1982 at rates of 7 and 6 kg/ha respectively. However, drought was experienced in 1982/3 and the area was resown on 23rd October 1984 at rates of 9 and 4 kg/ha respectively. By 1988 lucerne was sparse on the lower two replicates. On 25th October, 1988, following a winter fallow, the area was sown to phalaris (Sirosa 3 kg/ha, Australian 1 kg/ha). Fertiliser was drop-spread annually. Over the 15 years to 1996, applications totalled 152 kg phosphorus/ha, 108 kg sulphur/ha and 213 kg potassium/ha. Copper (50 g/ha) and molybdenum (25 g/ha) were applied in 1986. Herbage production was measured by mowing strips at 2.5 cm height. The area was rotationally grazed with sheep. After each harvest samples were cut with hand-shears at 1.0 cm height before each harvest. Plots were harvested on six occasions during the lucerne phase (1983-86), and on 11 occasions during the phalaris phase (1989-94) and samples were taken to determine dry matter (DM) content. Samples were taken from 20 locations/plot, sorted, dried and weighed. Samples dried at 65°C were chemically analysed. Lucerne was sampled on 31st March, 1986. Sub clover and phalaris was sampled on 7th September, 1993 when samples from replicates were pooled. Lucerne plants were counted in 12 permanently-marked 0.5 m lengths of drill row on four occasions. Sub clover and phalaris seedlings were counted in a set of randomly located quadrats. Soil was sampled prior to liming, by taking 5 cores per replicate to a depth of 90 cm Table 1). Top-soil samples were taken in August 1983 and January 1989 for determination of pH and exchangeable aluminium. Soil and herbage analyses were as described by Brown *et al.* (1980).

RESULTS AND DISCUSSION

A year after liming, pH was significantly higher and exchangeable aluminium significantly lower on all lime treatments. After 7 years the effect on pH was evident in plots that had received at least 1.0 t lime/ha; exchangeable Al was significantly lower on plots that had had at least 2 t/ha (Table 2). Initially, lucerne plant density was not affected by lime rate but two years after establishment, plots that had received less than 2t/ha had significantly fewer plants (Table 3). Over the years 1983-86 lucerne harvests were made in all seasons of the year. The cumulative yield of lucerne from these harvests was curvilinearly related to lime rate:

Yield (lucerne dry matter, t/ha) = 3.06 - (0.07 x rate) + (1.50 x šrate), standard error of yield estimate = 0.97; 100 r^2 = 96.6.

During the phalaris phase, cumulative yield was again curvilinearly related to lime rate. The rate of yield increase was much less than that measured with lucerne:

Yield (phalaris DM, t/ha) = 12.62 + (0.01 x rate) + (0.51 x šrate) standard error of yield estimate = 0.135, 100 r^2 = 97.2.

Nutrient concentrations in lucerne (year 4), showed little effect of lime rate; manganese declined and molybdenum increased with lime. In year 11 when effects were measured in phalaris and sub clover, manganese concentrations had declined considerably with lime. Cu concentration in sub clover seemed to decrease with lime, and phosphorus and sulphur concentrations increased in phalaris. Calcium increased in both species (Table 4). Baker (1992) previously reported that within this experiment, lime had no effect on numbers of earthworms per unit area but did affect species distribution. The introduced species, *Octolasion cyaneum* and *Microscolex dubius* increased with lime; some native species declined. The value of lime for phalaris production has sometimes been attributed to alleviation of manganese toxicity (Helyar and Anderson 1974). Herbage Mn levels were not high in this study. The effect of lime may have been due to residual nitrogen fixed by lucerne, alleviation of aluminium toxicity (Ridley and Coventry, 1992) or improvement of the phosphorus nutrition. A study of the effect of lime on various phosphorus fractions is now in progress at the site of this long-term experiment.

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