Phosphorus and sulfur interactions in soil-plant systems. I. uptake of P and S by plants grown in undrained pasture cores.

A. P. Kennedy and A.R. Till

CSIRO Pastoral Research Laboratory, Armidale

Most Australian soils are phosphorus-deficient and this is usually corrected by applying superphosphate. Sulphur deficiency is also wide-spread but, as superphosphate also contains about 12% S, this deficiency may be corrected incidentally in pasture being treated for phosphorus deficiency. Phosphorus can affect the adsorption and consequently the retention and/or the availability of sulphur in soils and field studies have shown reduced pasture growth with high phosphorus application and high stocking rates (1). A series of experiments is in progress at CSIRO, Armidale. to study the plant and animal responses to different forms of applied fertilizer phosphorus and sulphur and the interactions between them. The results presented here are part of this series and describe the effect of the form of applied phosphorus on the uptake of phosphorus and sulphur by pasture cores maintained under controlled conditions.

Methods

Intact cores, 10 cm deep, were cut from a *Poa pratensis* pasture by driving in sections of 16 cm diameter PVC tube. Each tube, complete with core was then sealed at the bottom using a PVC end-fitting. The cores were placed in three controlled cabinets, night/day temperatures 8/14?C, 18/24?C, 21/27?C and watered to 70% of field capacity. A replicated trial was carried out at each temperature, using three materials (superphosphate, lime-coated superphosphate (and rock phosphate) at three levels of phosphorus (0, 20 and 50 kg P ha-1), except lime-coated superphosphate was not applied at 20 kg P ha-1. The rock phosphate cores were brought to equivalent sulphur status with gypsum. The "available" phosphorus in each core was labelled with ^{32}P 14 days before fertilizer application. The pasture was cut to a height of 2 cm every 14 days for 14 samplings and analysed for phosphorus, sulphur and radioactivity. Pasture uptake of fertilizer phosphorus was calculated from the ratios of the specific radioactivities of the phosphorus in the plants growing in the control and treated cores.

Results and Discussion

Cumulative plant production averaged 3.9t ha^{-1} in the 8?/14?C cabinet and 6.2t ha-^{1} in the higher-temperature cabinets. There was no significant fertilizer effect, presumably because of the high bicarbonate-extractable phosphorus (>35ug g-^{1}). However, there were significant differences in the phosphorus content of the pasture and in the percentage of fertilizer phosphorus taken up by the plant (Table 1).

Table 1. Mean P content (stand. dev.) and fertilizer uptake by plants

APPLICATION RATE	P content of plants (%DM)				Fertilizer (%) taken up by plant			
	Super	L.C. Super	Rock P		Super	L.C. Super	Rock P	
20 kg P ha-1	0.464 (.087)	N.A.	0.370 (.046)		36	N.A.	0	
50 kg P ha^{-1}	0.548 (.074)	0.495 (.062)	0.353 (.044)		29	17	0	

The different materials made no significant difference to the sulphur uptake and it was not until 12 weeks after application that a significant difference developed between the treated and control cores. This may have been due to the system used, precluding the loss of sulphur from the root zone, and/or the high soil sulphur content (340ug g-1). These restraints could be very significant in the field and are being investigated by labelling "available" S with ^{35}S and "available" P with repeated doses of 32p.

1. Lodge, G.M. and Roberts, E.A. 1979. Aust. J. Exp. Agric. Anim. Husb. 19: 698-705.